COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF PUBLIC INSTRUCTION

ALL-DAY VOCATIONAL TRADE

OR

INDUSTRIAL SCHOOLS AND DEPARTMENTS

(REVISED REPRINT)

Bulletin 7
Harrisburg, Pennsylvania
1927

COMMONWEALTH OF PENNSYLVANIA

DEPARTMENT OF PUBLIC INSTRUCTION

Harrisburg

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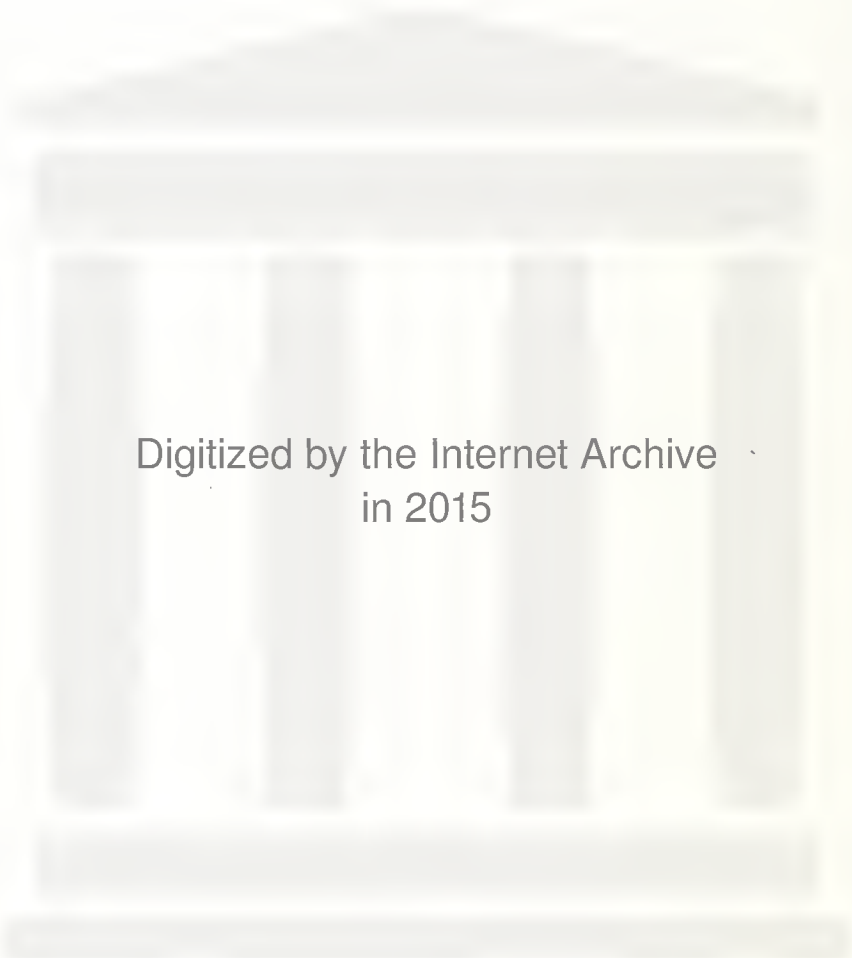


FOREWORD

Education and training for workmen in the skilled trades has long occupied a very prominent place in the social and economic development of our country. The all-day trade school was one of the earliest methods by which public and private agencies attempted to educate and train skilled workers to meet the needs of industry. Other methods of providing for this type of education and training have been tried and are still in the process of development. These other methods include education and training by means of part-time and evening schools.

A distinct advantage of the all-day school for trade training is its permanence and stability. Its operation is independent of industrial prosperity or depression. On the other hand a disadvantage of this type of organization is the cost of equipment and the limited number of skilled trades for which training can be given in any one center.

Undoubtedly the all-day trade school has performed and will continue to perform a distinct service to the youth of our country in preparing for entrance into skilled industrial occupations. It can be assumed, therefore, that the all-day trade school is an important part of Pennsylvania's Educational System.

This Bulletin has been prepared for the purpose of giving public school districts definite information that should lead to the establishment and operation of effective unit trade courses where they are needed. The Bulletin also is intended to provide standards for the administration, courses of study and methods of instruction for all-day vocational trade or industrial schools and departments.

The following persons rendered valuable assistance in the preparation of this Bulletin: Mr. C. F. Bauder, Director of Vocational Education, Philadelphia; Mr. Raymond Hawke, Principal, The North Braddock General Industrial School, North Braddock; Dr. A. S. Hurrell, Professor of Vocational Education, The Pennsylvania State College, State College; Mr. James Killius, Director of Vocational Education, Johnstown; Mr. Frank M. Leavitt, Associate Superintendent of Schools, Pittsburgh; Mr. J. W. Martin, Director of Vocational Education, Coatesville; Mr. George H. Parkes, Director of Vocational Education, Williamsport; Mr. James C. Tucker, State Department of Welfare, Harrisburg; Mr. M. M. Walter, Director of Vocational Education, Bethlehem; Mr. G. G. Weaver, Professor of Vocational Education, University of Pittsburgh, Pittsburgh; and Mr. W. K. Yocum, formerly of Williamsport, more recently of the Yocum Automobile School, Wilmington, Delaware. A number of others contributed material which has been used in the preparation of this Bulletin. The Department is indebted to all persons who in any way contributed to the value of this work.

This bulletin was prepared by Mr. W. P. Loomis, formerly of this Department, under the direction of Deputy Superintendent of Public Instruction L. H. Dennis. Revisions have been made by Mr. P. L. Cressman, Assistant Director of Vocational Education and his associates Mr. C. E. Hedden and Mr. J. J. Matthews, Supervisors of Industrial Education in the Vocational Division.

John A. H. Keith
Superintendent of Public Instruction

January 1928

TABLE OF CONTENTS.

PART I

ADMINISTRATION AND COURSES OF STUDY FOR VOCATIONAL UNIT TRADE CLASSES

PART II

ADMINISTRATION AND COURSES OF STUDY FOR VOCATIONAL GENERAL INDUSTRIAL CLASSES

PART I

ADMINISTRATION AND COURSES OF STUDY FOR VOCATIONAL UNIT TRADE CLASSES.

I. UNIT TRADE COURSE DEFINED

Definition. A unit trade course fits properly qualified unemployed persons of high school age for profitable participation in a particular trade or other skilled industrial occupation, through instruction of less than college grade. Thus if a group of such young persons attend an all-day class in a school in order to prepare themselves to be electricians, and if the instruction both in shop work and related subjects, is based on the requirements of the occupation, this constitutes a unit trade class in the electrician's trade when conducted in accordance with the State plan for such classes.

Derivation of the Term "Unit Trade." The term "unit trade" is used in designating these courses in accordance with an agreement between the State Council of Education and the Federal Board for Vocational Education. Special regulations governing the establishment and operation of unit trade courses are fixed in part by State and Federal statutes and in part by the State plan for this type of course. These regulations will be discussed in Part I, Sections IV to XII of this Bulletin.

Comparison of Unit Trade Classes with Other Industrial Classes. In acquiring a clear understanding of unit trade courses it is necessary to have in mind not only a knowledge of the fundamental parts of such courses, but also to have a perception of how these courses differ essentially from vocational general industrial, part-time co-operative and industrial arts courses from the standpoint of organization.

A. A unit trade course is the type which must be used in cities of 25,000 population and over, while a vocational general industrial course is permitted in communities of less population.

B. A unit trade course provides for instruction in one particular trade, while in a vocational general industrial course, instruction is given to each student in two or more trades of a related group.

C. A unit trade course provides complete instruction in shop work, subjects related to the trade, and non-vocational subjects all of which are under the supervision and control of the school authorities, while a part-time co-operative course provides only for instruction in related and non-vocational subjects by the school during part of the working time. The shop work in co-operative courses is given

under the supervision and control of the industry during the remainder of the working time.

D. A unit trade course provides that a large proportion of the school time be devoted to shop work and related subjects and a comparatively small amount of time to non-vocational subjects, while the industrial arts course gives a large amount of time to non-vocational subjects, considerably less time to shop work, and often no time to related instruction.

II. SHOULD UNIT TRADE COURSES BE CONDUCTED IN HIGH SCHOOLS?

Importance of Carefully Considering the Problem. All aspects should be considered carefully before establishing unit trade courses in existing high schools or in new ones which will be established. This holds true whether the community be large or small. The importance of a careful study of the problem is emphasized by the fact that the attractiveness of a unit trade program rather than the need for it is likely to lead to an unscrutinized acceptance by those accustomed to the administration of general education in high schools.

Factors Affecting the Establishment of Unit Trade Courses as Departments in High Schools. Unit trade courses should be established in senior high schools if the conditions surrounding such a move point conclusively to success from the standpoint of service to the community and administration in the school. The salient points to be considered are as follows:

A. Is there a sufficient demand for trained workers in the community to absorb a reasonable output by the school, and is this demand permanent?

B. Are the occupations for which the demand exists of such a nature that a school training of secondary grade can be given?

C. Will a sufficient number of pupils from the community which the high school serves be interested in the pursuit of courses to warrant their operation?

D. Are proper shop and classroom facilities available for giving adequate instruction, or is sufficient money available to provide these facilities?

E. Is it possible or advisable to adapt the organization of the high school to the requirements of unit trade courses in regard to pupils, instruction, hours of work, teachers and supervision?

F. Are the school principal and faculty acquainted with and in sympathetic accord with the fundamental aims of unit trade courses?

Unit Trade Courses in the Large Cities. In the larger community it is often advisable to establish a trade high school or a system of such schools to meet the need for and requirements of unit trade courses. It may be found inadvisable to establish trade courses in connection with existing high school organizations and at the same time be of utmost importance that separate trade high schools should be established. A number of factors may enter into the determination of the need for trade schools, among the most important of which are the variety of courses and the number and distribution of pupils.

Unit Trade Courses in Junior High Schools. The question of the advisability of establishing unit trade courses in junior high schools deserves special consideration. It often happens that boys who attend this school are not ready to make a vocational choice at the time of entrance or during their stay in the school. The junior high school period comes at a time when the majority of pupils are seeking to find their vocations rather than to learn them. Other considerations, as stated previously in this section, being favorable to the establishment of unit trade courses in junior high schools, such courses should be established only after a special study indicates conclusively that a sufficient and permanent demand for this type of instruction exists among the more mature pupils of the eighth and ninth school years.

III. GENERAL AIMS FOR UNIT TRADE COURSES

Preparation for Vocation. To prepare for useful employment in a specific industrial occupation is the controlling purpose and aim of a unit trade course. The success of such a course will be determined largely by the interpretation of this aim within the school.

It should be constantly borne in mind that a unit trade course to be really successful must fit those who complete it to enter the trade with advanced standing and, other things being equal, to advance faster and farther than apprentices or journeymen who have not pursued studies of a similar nature. A well-balanced and effective course in shop work and related subjects will lay the foundation for the development of a high type of workman who is capable of assuming a creditable place in industry, and who is also eligible for leadership.

Preparation for Citizenship. Preparation for effective participation in the social and civic duties and privileges of a citizen and in other leisure time activities should always be an aim for unit trade courses. It is very important that this part of the curriculum should receive adequate attention and that no essential subject be omitted.

IV. BASIS FOR ESTABLISHING UNIT TRADE COURSES

Preliminary Study to Determine Needs. Preliminary study is necessary in order to determine the need for unit trade courses in a given community. Courses will be most successful that lead to immediate employment upon completion and from which, by virtue of proper training, the graduates attain a marked degree of success as they become experienced in their occupations.

Basis for Studying the Problem. The only sure way of arriving at a safe estimate of the industrial education needs of a community is through the medium of a survey. For the purpose of determining the need for unit trade courses, the study should be limited to the community served by the school both from the standpoint of pupils and employment. The following essentials for a preliminary survey will meet the requirements in the majority of cases.

A. The preliminary survey should be made by one or more persons, depending on its magnitude. These persons should be selected from an existing vocational education staff or from other qualified agencies if no such staff exists at the time the survey is made.

B. In making the survey, co-operation and assistance should be secured from the schools, the industries, and business, civic, and other community organizations. Much interest in and support of the project will be obtained if such agencies are properly utilized.

C. Existing data in regard to school, industrial and community conditions should be always utilized.

D. Information should be obtained and tabulated in regard to industries which will show for each skilled trade or industrial occupation having more than fifty men employed, number employed, yearly absorbing capacity, technical information needed for proficiency, requirements in regard to skill, length and nature of learning period in industry, and opportunity for advancement.

E. Existing school facilities should be studied in regard to the adequacy and suitability of available space and the adaptability of the present equipment. The existing shop equipment in a school should not be an influence in favor of the establishment of any particular unit trade course.

F. The population from which the school draws should be studied in order to determine the occupations of the parents, the number of and cause for drop-outs during the period of at least a year and the aims of present high school pupils. From this information the probable number of pupils available for unit trade courses in the high school may be predicted.

G. Conclusions should be drawn in regard to the courses which ought to be established.

H. Estimates should be made in regard to the preliminary expenditure of funds needed to provide space and equipment for the courses and the yearly expenditure which will be necessary to carry on the work.

I. The financial requirements for establishing and conducting the work should be carefully studied in terms of the community's resources.

Continuity of the Survey. The industrial survey should continue as long as the unit trade courses are conducted. It should always be up to date. It can never be completed, for the conditions which it studies are always changing. The industrial education staff under proper leadership should continuously be engaged in improving the work of the courses and outlining plans for greater service to the community.

V. GENERAL ORGANIZATION OF UNIT TRADE COURSES.

Courses in the Trade High School

A. Trade schools may be of junior or senior grade. A school which admits pupils fourteen years of age who have completed the sixth school year and which continues for two or three years is classed as a Junior Trade High School. A trade school which admits pupils fourteen years of age who have completed the ninth school year and which continues two or three years is classed as a Senior Trade High School.

B. In this school only industrial courses will be conducted. It may contain four types of departments, i. e. prevocational, unit trade, general industrial or part-time co-operative.

C. Each department will have a head and each school will have a principal who will be particularly qualified for his position.

D. The heads of departments will be responsible to the principal, who in turn will be responsible to the superintendent of schools, either directly or through an assistant superintendent or director of vocational education.

Courses in the Senior High School.

A. Under this head will be considered high schools of three-year course requiring the completion of the ninth school year for entrance.

B. The senior high school that offers unit trade courses should have an industrial department. All trade or industrial courses should be included in this department.

C. There should be a head of the industrial department responsible to the principal of the high school in the matters of general school administration and to the person charged with the direction of industrial education in all matters which will affect the extent or quality of the industrial instruction.

D. The high school schedule should be sufficiently flexible to admit of the successful operation of the unit trade classes.

Courses in the Junior High School

A. The same general principles hold for organizing unit trade courses in junior high schools as have been stated for senior high schools. (See Section II of Part I on trade courses in junior high schools).

Courses in the Four Year High School

A. The same general principles of organization which have been stated for the senior high school may be used for four-year high schools.

VI. SCHOOL CONDITIONS AFFECTING UNIT TRADE COURSES IN ANY SCHOOL

The School Superintendent. It is obviously essential that the superintendent of schools give positive support to the program.

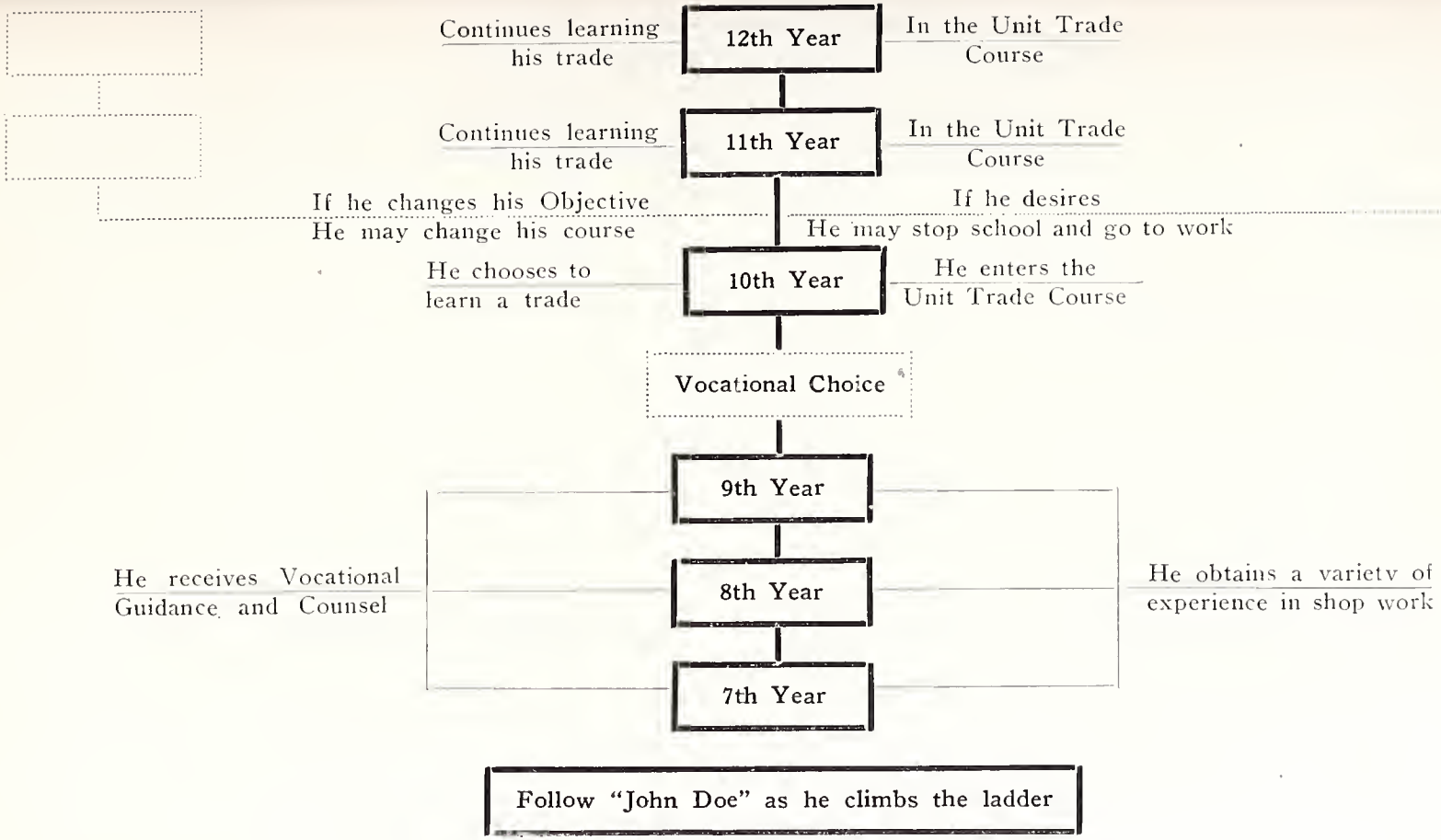
School Principals and Teachers. School principals and teachers should have an intelligent understanding of the aims of unit trade instruction.

Definite Lines of Authority. There should be a clear understanding among the superintendent of schools, the high school principal and the director of industrial education in regard to lines of authority and responsibility for the administration and supervision of the trade courses.

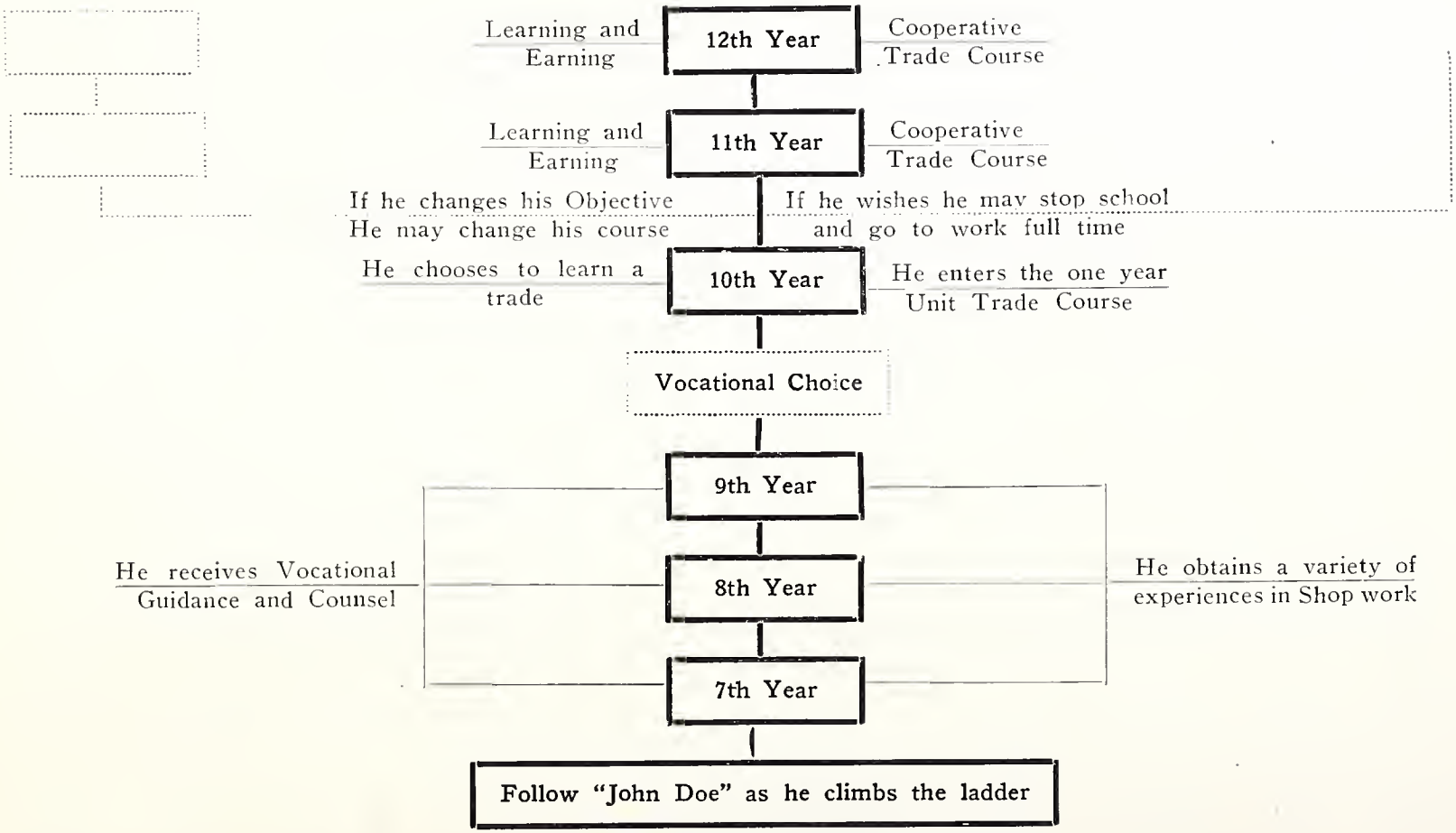
Effective Supervision. The person in charge of directing industrial courses should have a position in the school system which will enable him to perform effectively his administrative and supervisory duties.

Vocational Choice. Means should be provided to enable all students to choose their courses wisely. Trade sampling or shop tryout courses and effective vocational counsel will do much to accomplish this end. It should be clear at all times that unit trade courses are not conducted in order to provide a dumping ground for those who do not have the mental ability for success in academic courses. Opportunity should be given, however, to change from one course to another, when advisable.

Student Counselors. Each student should be assigned a member of the teaching staff to whom he may go for counsel and advice on his educational and vocational objectives.



POSSIBLE ORGANIZATION FOR THREE YEAR UNIT TRADE COURSES IN SENIOR HIGH SCHOOLS



MERGING UNIT TRADE INSTRUCTION WITH COOPERATIVE INSTRUCTION

VII. SCHOOL AND INDUSTRIAL RELATIONS THAT AFFECT THE SUCCESS OF UNIT TRADE COURSES.

Agencies of Co-operation. General co-operation should be maintained by the schools with individuals and organizations representing both employers and employees.

Mutual Confidence Must Be Maintained. There must be mutual confidence on the part of all parties concerned and a belief in the sincerity of purpose between those who are offering the unit trade courses and those who will be benefited by them.

Method of Co-operation. Advisory councils may be appointed which provide fair representation of all interested parties. The purpose of these councils is to bring to the schools a knowledge of the school needs of the pupils in terms of requirements in industry. It should be clearly understood that the function of an advisory council is to give advice and counsel and not to initiate or execute educational policies.

Recognition of School Training. The school should give the best possible training in each trade and should get for each graduate proper recognition in industry for the preparatory work done in school. In this connection a placement service should be maintained by the school for the benefit of its graduates. Such service will do much to bring about mutual co-operation between the school and industry.

VIII. SPECIFIC REQUIREMENTS FOR UNIT TRADE COURSES FIXED BY LAW.

Supervision and Control. Classes must be under public supervision and control.

Grade of Instruction. Instruction must be of less than college grade. It must be designed to meet the needs of persons over 14 years of age.

Age of Admission. Only pupils over 14 years of age may be admitted.

Time for Shop Work. At least one-half of the school time must be given to shop work.

Length of Term and Hours of Instruction. The minimum length of term is nine months (36 weeks) and the minimum time for instruction per week is thirty (30) clock hours for communities of 25,000 population and over.

IX. STANDARDS INDICATED IN THE LAW FOR UNIT TRADE COURSES BUT INTERPRETED BY THE STATE.

Controlling Purpose. A general discussion of the aims for this instruction will be found in Part I, Section III, of this Bulletin. Specific aims by years will be found in Part I, Section XIII.

Length of Term and Hours of Instruction in Communities of Less than 25,000 Population. The minimum term is nine months (36 weeks) and the minimum time for instruction per week is twenty-five (25) clock hours. A longer term and more hours per week is sometimes desirable.

Shop Instruction. The law requires that the shop work be done on a useful productive basis. A number of interpretations of this requirement are possible. Basically, however, it must mean work which is similar to that done by the journeyman at his trade or occupation. The requirement also strongly implies that the product of the shop must have an economic value from the same standpoint as that which obtains in industry. This interpretation will be the test of useful or productive work in unit trade shops. Methods of instruction are discussed in Part I, Section XX, of this Bulletin.

Related and Non-vocational Instruction. Instruction in subjects related to the trade and in other subjects of a general nature is required. The proportionate amount of time devoted to instruction in these two types of subjects is determined by the needs for instruction related to the trade with due consideration to the social and civic education of the individual. The percentage of time ordinarily given to each is discussed in Part I, Section XIV. Methods of instruction for related subjects are discussed in Part I, Section XX of this bulletin.

Segregated Classes. For shop and related subject classes only trade students may be given instruction in a given shop or classroom at the same time. If two groups of students are to receive instruction in a given shop, one for the purpose of related information and the other for the purpose of trade practice, these classes may not be held at the same time unless the facilities are adequate and two instructors are used. Likewise, instruction in a related subject may not be given to trade students in the same class with students from non-vocational courses.

Selection of Courses by Students and Capacity for Doing Work. Training for a particular trade implies selection of this trade as a preparation for his life work by the individual, and the possession of suitable inherent characteristics which will make for success after completion of the training period. It is highly important, therefore, that each individual be given ample opportunity through tryout courses to select intelligently the particular trade course that he desires to pursue. It is also just as important that each prospective student be given adequate counsel and advice in regard to his qualifications for participation in each available trade and any other consideration which might affect his selection.

It should be noted in this connection that trade courses of this type are not intended for subnormal individuals. Each individual should have the ability to do the work of the course he selects. Trade and other occupations which are taught in high schools require a high degree of skill in performance and considerable mental ability. Training courses for the so-called "operative occupations," which require very little manual dexterity or thinking ability, are not at the present time offered in the high schools of Pennsylvania.

Plant and Equipment. The plant and equipment must in every case be adequate to meet the requirements of the course. Specific considerations in regard to plant and equipment are given in Part I, Section XXI, of this Bulletin.

Maintenance. Maintenance may be divided into three main headings—Salaries, Upkeep, and Supplies. Adequate maintenance is required of all school districts conducting unit trade courses.

A. *Salaries.* Salary schedules of teachers in unit trade courses will be based on the same scale as for other teachers in high schools. Salaries will be affected, however, by the teacher supply and opportunities in industrial occupations. It will be found in most instances that the salary cost per pupil is somewhat higher in unit trade courses than in other high school courses. This is due largely to the fact that shop classes are of necessity smaller than in some other high school courses.

B. *Upkeep.* Upkeep of equipment consists of repair and replacement. This will vary somewhat with the trade and the care used by the instructor in the management of his classes. This item is worthy of consideration, however, and adds to the cost of maintenance of unit trade courses.

C. *Supplies.* The cost of supplies varies with different courses and with the product that is made in the shop. Shop supplies are expensive and must often be purchased in quantities. The net cost of supplies may be reduced by utilizing the value of the trade product. This may be disposed of to the school system or other agencies. The value of all products and services should be recorded in a systematic manner. That which is consumed by the school should be calculated at market value.

D. *Net Cost of Maintenance.* In determining the net cost of maintenance the value of the trade product should be deducted from the gross expenditures. The cost to the district is further reduced by the special aid for teachers' salaries which is available from State and Federal funds.

E. *Qualifications and Certification of Teachers.* Teachers in unit trade courses are classed as shop teachers, related subjects teachers and academic (non-vocational) teachers. Standards of qualifications and certification for these teachers are set up by the State Council of Education and may be procured from the Teacher Bureau, Pennsylvania Department of Public Instruction, Harrisburg.

X. VARIABLE CONDITIONS SURROUNDING THE OPERATION OF UNIT TRADE COURSES.

Kinds of Trades Taught. Kinds of trades or occupations which will be taught are determined largely by local needs.

Length of Course. Unit trade courses will in general cover a training period of from one to four years.

When Courses May Begin. Unit trade courses may be established to begin after the completion of any high school year.

Combination with Other Courses. Unit trade courses may be combined with part-time co-operative courses to suit the need and possibilities of the community.

XI. INITIAL STEPS IN INVESTIGATING THE NEED FOR AND OBTAINING STATE APPROVAL OF THE ESTABLISHMENT OF UNIT TRADE COURSES.

Informal Statement. Make an informal statement of this intention to the State Superintendent of Public Instruction.

Preliminary Investigation. A representative or representatives of the Department of Public Instruction will make a preliminary investigation of the situation and give assistance in planning for and making a survey to determine the needs of the community and the advisability of establishing courses.

Authorization to Operate. If it is found advisable to establish courses, a formal "Application for Authorization to Operate a State Aided Vocational Industrial School or Department" may be made.

Institution of Courses. Upon the approval of this application definite plans should be made to institute the work.

XII. GENERAL CONSIDERATIONS IN PLANNING THE SCHOOL PLANT AND EQUIPMENT FOR UNIT TRADE COURSES.

Types of Schools to Be Considered. As indicated in Part I, Section V, of this Bulletin, four types of high schools may have unit trade courses as follows:

A. Trade high schools.
B. Senior high schools.
C. Junior high schools.
D. Four-year high schools.

Similar Plant and Equipment for all Types. In general what is said about plant or equipment in one of these schools will be equally true for the others. Specific standards are set up in Part I, Section XXI, of this Bulletin.

Persons and Agencies to be Consulted when Planning. It is assumed that the board of school directors and the superintendent of schools will be familiar with all plans which are made for the school district. Active agencies that should make valuable contributions in planning for the plant and equipment may be listed as follows:

A. The school architect.
B. The school principal.
C. The person in charge of industrial education for the school district.
D. "Advisory Councils" as indicated in Part I, Section VII.
E. The shop teachers.
F. The Department of Public Instruction.

XIII. SPECIFIC AIMS APPLICABLE TO INSTRUCTIONS IN ANY TRADE.

Shop Instruction. As stated in Part I, Section III, of this Bulletin, the controlling aim for shop work is preparation for useful employment in a specific occupation. In order to bring about the consummation of this aim it is necessary to plan for specific developments in the individual from the standpoint of his ability to work successfully at his occupation and to have the proper understanding and viewpoint in regard to his work. It follows that in the stages of this development the teacher should have in mind the order and importance of each particular step which will, in the end, be productive of a finished individual in the vocation. A well-rounded experience in the occupation should always be provided.

A. The aims for the beginning year in order of their importance are as follows:

1. A preliminary knowledge of and ability in the performance of fundamental processes on specific jobs should be acquired by the student apprentice. The ability to analyze each particular trade job into its consecutive operations should be developed.
2. A proper acquaintance with the environment of the trade should be developed. During this period the student is being introduced to his trade. His first impression will influence his ideals and activities as he progresses with his work. It is important, therefore, that he develop at the beginning of his experience the right attitude toward the environment of his occupation, a whole-

some respect for the value and importance of his work, high ideals in regard to his relationships with his fellow workers and his boss, and a correct familiarity with the implements and materials with which he works.

3. An appreciation of industrial production should be developed. Productive work in the school shop not only implies a useful product but also conformity with the industrial production methods. A variety of experiences in a well-organized shop brings appreciation of the completed product rather than knowledge of but the one particular operation on which the student may be working at any given time.

4. Accuracy and neatness to meet the requirements of the product, and speed in production should be developed. Proper supervision of the learner's working methods and insistance upon adequate accuracy and neatness of the completed job will develop a conception of the correct standards of workmanship for his trade work. By continued repetition of each process speed will be developed. Repetition should not be carried to the point where the educational need is exceeded.

5. The vocational choice of the student should be confirmed. This year is the probationary period by which the student will find whether or not his physical or mental abilities are such that he will enjoy his work and be able to be a success in his occupation. It is the responsibility of the shop teacher and director to eliminate misfits from each course and assist them in finding their proper places.

B. Aims for the middle year or years in order of their relative importance are given below.

1. A further appreciation of and ability in production should be developed. The student is now moving rapidly toward mature ability as a worker. He is beginning to possess, to a measurable extent, the thinking and working powers of a journeyman. A combination of the first and third aims which are stated for the beginning years is necessary here.

2. An appreciation of the elements of shop organization and management should be developed. The learner should acquire a definite understanding of the manner in which the shop is organized and managed. Such an aim is essential to the development of leadership.

3. A further development of accuracy, neatness and speed in production is essential during this period of training. See fourth aim of the beginning year.

C. Aims for the last year in order of their importance are as follows:

1. Leadership should be developed. This aim may be accomplished by having the students participate in the management of the shop.
2. Further appreciation of and ability in production, accuracy, neatness, and speed should be developed. See first, third, and fourth aims of the beginning year.

Related Instruction. In stating the specific aims for related instruction it will not be necessary so definitely to differentiate the value of the aims for each year of the course. The related instruction is supplementary to the shop instruction, however, and it is therefore apparent that the aims for related instruction follow closely the development of the student in his shop work. The following aims indicate those which should be kept in mind for related subject instruction. The order in which they are given does not indicate their importance. Each aim should be fulfilled to meet the requirements of the occupation and the aims for shop work.

A. *Drawing.* Ability to construct or interpret drawings or both in accordance with occupational requirements should be developed. (Note: In the case of the drafting trade related shop instruction should be provided in place of drawing as a related subject.)

B. *Mathematics.* Ability to make all calculations which are necessary in trade practice should be developed.

C. *Science.* A knowledge of scientific principles and facts which have to do with the materials and implements of the trade or the performance of work should be developed. Ability to apply scientific principles to actual trade problems should also be developed.

D. *Trade Theory.* The student should become familiar with the names, construction, uses, care, and other essential information about the machines, tools and special equipment used in the occupation.

A knowledge of the methods of analyzing jobs, and the various methods used in doing jobs should be developed in the student.

An appreciation of the requirements of the various products common to the trade should be acquired by the student.

An understanding of the fundamental principles of shop organization should be developed.

A knowledge of the historical development of the trade should be acquired by the student.

He should also develop an appreciation and an elementary knowledge of the hygiene of his trade and safety first precautions.

Non-vocational Instruction. This work is given to aid in the general development of the individual from a social, civic and a vocational standpoint. The aims and objectives for the non-vocational subjects will be the same as when these are given in connection with other high school courses and will be found stated in the high school courses of study that deal with each non-vocational subject taught in unit trade courses.

XIV. SUBJECTS AND TOPICS TO BE TREATED IN UNIT TRADE COURSES.

The Division of Time between Shop Work, Related Instruction and Non-vocational Instruction. It is important to keep in mind the relative proportions into which the school week is usually divided in order to provide for the three classes of instruction required. As indicated in Part I, Sections VIII and IX, of this Bulletin, a very specific requirement is set for shop work and certain interpretable standards are indicated for related and non-vocational subjects. All courses should be planned, in the light of the standards given below, to meet the requirements of the trade under consideration.

A. *Shop Work.* At least one-half the time must be given to practical work on a useful or productive basis. This minimum is set by law and is inflexible if State recognition as a unit trade course is desired.

For a thirty-hour week at least fifteen hours must be given to shop work. This is an average of three clock hours per day for the five school days. It is not required that three hours be scheduled each day so long as the fifteen hours of shop work are completed within the week.

B. *Related Studies.* The amount of time given to these studies is somewhat variable and depends upon the relative amount of time "necessary to build well-rounded courses of study" and upon the requirements of the trade. The amount of time usually given to related instruction varies from 20 to 30 per cent of the total time which is available during the week.

For a certain course it might happen that during one year six hours ought to be devoted to relative instruction while another year might require seven hours, and in still an-

other year nine hours might be needed. The time requirements for related studies also vary with different trades.

C. *Non-vocational Studies.* As in the case of related instruction, the amount of time devoted to this work is variable. It is recognized that the social and civic education of the industrial worker is important and therefore sufficient time must be given to care for his education in this respect. Time is available, however, for only the essential subjects, From 20 to 30 per cent of the total time available is given to instruction in non-vocational studies.

Given a thirty-hour week, it will be found that from six to nine hours is the variable amount of time devoted to this instruction.

XV. SUGGESTIVE TRADES WHICH MAY BE TAUGHT BY MEANS OF UNIT TRADE COURSES.

A variety of trades have been taught successfully by means of unit trade courses. In naming these occupations it is advisable to recognize for the purpose of school classification, first the trade group and second the particular trades within each group.

A. *Building and related trades*—Architectural draftsmen, bricklayers, cabinetmakers, carpenters, concrete workers, house wire men, interior decorators, painters, paperhangers, plasterers, plumbers, sheetmetal workers, stone masons, tilesetters, etc.

B. *Electrical and related trades*—Armature winders, automobile electricians, electrical repairmen (general), electrical testers (telephone or motor), house wiremen, power plant engineers, telegraphers, telephone repairmen.

C. *Machine and related trades.* Automobile mechanics, blacksmiths, machinists, mechanical draftsmen, molders, patternmakers, sheetmetal workers, stationary engineers, toolmakers, etc.

D. *Miscellaneous trades in manufacturing and mechanical industries.* Bakers, cobblers, dressmakers, milliners, power machine operators, tailors, weavers, etc.

E. *Personal services.* Barbers, chefs and cooks (in hotels and restaurants), hairdressers, launderers, manicurists, waiters, etc.

F. *Printing trades.* Bookbinders, compositors, electrotypers, engravers, linotypers, pressmen, printers, typesetters, etc.

XVI. CURRICULUMS FOR UNIT TRADE COURSES.

Typical Examples of Curriculums. Curriculums for all of the trades of skilled occupations which it is possible to teach by means

of unit trade courses will not be given in this outline. Detailed curriculums are outlined for several trades and assistance will be given by the Department of Public Instruction in planning additional ones not covered here.

The instructional time stated for each subject in the following curriculums is based on clock hours each week and the subjects are divided, with reference to type, into practical work, related instruction and non-vocational instruction. School credits are also shown. The number of hours for class subjects may be changed slightly when necessary to suit high school periods.

No time is scheduled for study periods due to the fact that trade courses must be intensive. Some of the time assigned to various subjects may be devoted to study during the class period under the supervision of the instructor in charge.

A. *Two-year curriculum in automobile repairing.* (Assuming completion of ninth year before entrance)

1. First year	Hours	Credit
Practical work		
Auto shop	15	1.5
Related instruction		
Machine drafting	2	.2
Mathematics	3	.6
Physics (½ year)	3	.3
Chemistry (½ year)	3	.3
Trade theory	1	.2
Non-vocational instruction		
English	3	.6
History	3	.6
Total	30	4.3

2. Second year	Hours	Credit
Practical work		
Auto shop	15	1.5
Related instruction		
Machine drafting	3	.3
Trade problems	3	.6
Trade theory	2	.4
History of automobile	1	.2
Non-vocational instruction		
English	3	.6
Civics (½ year)	3	.3
Economics (½ year)	3	.3
Total	30	4.2

B. *Two-year curriculum in carpentry.* (Assuming completion of ninth year before entrance)

1. First year	Hours	Credit
Practical work		
Carpentry work*	15	1.5
Related instruction		
Architectural drafting	3	.3
Mathematics	1	.2
Physics (½ year)	3	.3
Chemistry (½ year)	3	.3
Non-vocational instruction		
English	3	.6
History	3	.6
Economics	2	.4
Total	30	4.2

2. Second year	Hours	Credit
Practical work		
Carpentry work*	15	1.5
Related instruction		
Architectural drafting	4	.4
Trade problems	3	.6
Trade theory	2	.4
Non-vocational instruction		
English	3	.6
Civics (½ year)	3	.3
Contracts & specifications (½ year)	3	.3
Total	30	4.1

*Carpentry work on a useful or productive basis necessitates the construction of buildings which can be used after they are completed. Carpentry work therefore cannot be given entirely in the school shop.

C. *Three-year curriculum in mechanical drafting.* (Assuming completion of ninth school year before entrance)

1. First year	Hours	Credit
Practical work		
Drafting practice	15	1.5
Related instruction		
Pattern shop*	4	.4
Mathematics	2	.4
Physics (½ year)	3	.3
Chemistry (½ year)	3	.3

First year (Con.)	Hours	Credit
Non-vocational instruction		
English	3	.6
History	3	.6
Total	30	4.1

2. Second year	Hours	Credit
Practical work		
Drafting practice	15	1.5
Related instruction		
Machine shop*	4	.4
Trade problems	3	.6
Machine design	2	.4
Non-vocational instruction		
English	3	.6
Industrial history	3	.6
Total	30	4.1

3. Third year	Hours	Credit
Practical work		
Drafting practice	15	1.5
Related instruction		
Machine shop*	4	.4
Trade problems	3	.6
Trade theory	2	.4
Non-vocational instruction		
English	3	.6
Civics (½ year)	3	.3
Economics (½ year)	3	.3
Total	30	4.1

*Other shop subjects may be used if it seems advisable.

D. *Four-year curriculum in electrical wiring and testing.* (Assuming completion of eighth school year)

1. First year	Hours	Credit
Practical work		
Wiring	15	1.5
Related instruction		
Blue print reading and electrical drafting	2	.2
Physics	3	.6
Elementary electricity	2	.4
General mathematics	2	.4

First year (Con.)	Hours	Credit
Non-vocational instruction		
English	3	.6
History	3	.6
Total	30	4.3

2. Second year	Hours	Credit
Practical work		
Wiring	15	1.5
Related instruction		
Electrical drafting	2	.2
Chemistry	3	.6
Plane geometry	2	.4
Trade theory	2	.4
Non-vocational instruction		
English	3	.6
Civics	3	.6
Total	30	4.3

3. Third year	Hours	Credit
Practical work		
Testing	15	1.5
Related instruction		
Electrical drafting	2	.2
D. C. machinery	3	.6
Algebra (½ year)	3	.3
Solid geometry (½ year)	3	.3
Trade theory	1	.2
Non-vocational instruction		
English	3	.6
History	3	.6
Total	30	4.3

4. Fourth year	Hours	Credit
Practical work		
Testing	15	1.5
Related instruction		
Electrical drafting	2	.2
A. C. machinery	3	.6
General mathematics (advanced)	3	.6
Specifications	1	.2
Non-vocational instruction		
English	3	.6
Economics	3	.6
Total	30	4.3

E. *Two-year curriculum in machine shop practice.* (Assuming completion of ninth school year previous to entrance)

1. First year	Hours	Credit
Practical work		
Machine shop practice	15	1.5
Related instruction		
Machine drafting	3	.3
Mathematics	2	.4
Physics (½ year)	3	.3
Chemistry (½ year)	3	.3
Trade theory	1	.2
Non-vocational instruction		
English	3	.6
History	3	.6
Total	30	4.2

2. Second year	Hours	Credit
Practical work		
Machine shop practice	15	1.5
Related instruction		
Machine drafting	4	.4
Trade problems	3	.6
Trade theory	2	.4
Non-vocational instruction		
English	3	.6
Civics (½ year)	3	.3
Economics (½ year)	3	.3
Total	30	4.1

F. *Two-year curriculum in pattern making.* (Assuming completion of ninth school year before entrance)

1. First year	Hours	Credits
Practical work		
Pattern making	15	1.5
Related instruction		
Machine and pattern drafting	3	.3
Mathematics	2	.4
Physics (½ year)	3	.3
Chemistry (½ year)	3	.3
Trade theory	1	.2
Non-vocational instruction		
English	3	.6
History	3	.6
Total	30	4.2

2. Second year	Hours	Credit
Practical work		
Pattern making	15	1.5
Related instruction		
Machine and pattern drafting	4	.4
Trade problems	3	.6
Trade theory	2	.4
Non-vocational instruction		
English	3	.6
Civics (½ year)	3	.3
Economics (½ year)	3	.3
Total	30	4.1

G. *Three-year curriculum in printing.* (Assuming completion of ninth school year before entrance)

1. First year	Hours	Credits
Practical work		
Printing	15	1.5
Related instruction		
Design for printers	4	.4
Physics (½ year)	3	.3
Chemistry (½ year)	3	.3
Trade theory	1	.2
Non-vocational instruction		
English	4	.8
History	3	.6
Total	30	4.1

2. Second year	Hours	Credit
Practical work		
Printing	15	1.5
Related instruction		
Design for printers	6	.6
Mathematics	2	.4
Trade theory	1	.2
Non-vocational instruction		
English	3	.6
Civics	3	.6
Total	30	3.9

3. Third year	Hours	Credits
Practical work		
Printing	15	1.5

Third year (Con.)	Hours	Credits
Related instruction		
Design for printers	6	.6
Trade problems	2	.4
Trade theory	1	.2
Non-vocational instruction		
English	3	.6
Economics	3	.6
Total	30	3.9

H. *Two-year curriculum in sheet metal working.* (Assuming completion of ninth school year before entrance)

1. First year	Hours	Credit
Practical work		
Sheet metal working	15	1.5
Sheet metal drafting	4	.4
Related work		
Mathematics	2	.4
Physics (½ year)	3	.3
Chemistry (½ year)	3	.3
Non-vocational instruction		
English	3	.6
History	3	.6
Total	30	4.1

2. Second year	Hours	Credit
Practical work		
Sheet metal working	15	1.5
Sheet metal drafting	5	.5
Related instruction		
Trade problems	2	.4
Trade theory (½ year)	2	.2
Heating & ventilating (½ year)	2	.2
Non-vocational instruction		
English	3	.6
Civics (½ year)	3	.3
Economics (½ year)	3	.3
Total	30	4.0

XVII. SUBJECT MATTER FOR SHOP COURSES.

Typical Outlines of Subject Matter. The course outlines which follow are taken from actual practice in the schools of Pennsylvania. They are intended to be a guide in the operation of courses for the occupations included and in the formulation of courses for other subjects.

Each course outlined is separated into parts called "divisions" for the purpose of indicating a line of demarcation in formulating the courses by years. A course of two divisions does not necessarily demand two years of work. By a careful elimination of units, a two-division course may be reduced to meet the experience possibilities of a one-year course. On the other hand, this same two-division course may in some cases be extended to cover a training period of three or even four years by providing sufficient jobs. By receiving an increased amount of practice in shop work the student will acquire a greater degree of proficiency in his occupation.

Each "division" is divided into "blocks" which, for a given occupation, represent a basis for classifying jobs which are similar in character. To a certain degree it is possible to assign jobs in any block without previous preparation in other blocks. The units in the various blocks are arranged, as nearly as possible, in order of their difficulty.

It is, therefore, advisable for the instructor to make each assignment within a block in accordance with the ability of the individual student.

Type jobs are not always specified to cover the work of each instructional unit. In some cases it is essential that the type jobs be selected to meet the possibilities of the school. In all cases the instructor should feel free to select jobs which will give practice in the principles outlined for the unit.

A. *Shop work in automobile repair.*

First Division

Chassis

Unit A. R. 1 *Repairs to Springs and Shackles.* Bolts; shackles; clips; bushing; broken leaf; lubrication.

Unit A. R. 2 *Adjustments to Foot and Hand Levers and Brakes.* External; internal.

Unit A. R. 3 *Relining Brakes.* External; internal.

Unit A. R. 4 *Repairs and Adjustments to Wheels.* Wooden wheels; wire wheels; disc wheels.

Unit A. R. 5 *Tire Repair.* Removing tire; vulcanizing tube; repairing valve; replacing tire.

Unit A. R. 6 *Repairs to Frame.* Cold and hot straightening; riveting; breaks; new member; replacing running board bracket.

Body

Unit A. R. 7 *Adjustment to Body.* Body bolts; windshield; top.

Unit A. R. 8 *Replacement to Body.* Fenders; running board; buffer strips; door; hood fasteners; windshield glass.

Unit A. R. 9 *Repairing Dents and Breaks.* Fenders; body.

Front Axle

Unit A. R. 10 *Repairs to Axle.* Straightening; replacing bearing; aligning wheels.

Clutch and Universal Joint

Unit A. R. 11 *Replacements and Adjustments to Clutch.* Thrust bearing; spider; springs; leather; lubrication.

Throwout; bearings; metal disc; fabric.

Unit A. R. 12 *General Repairs and Adjustments to Clutch.* Springs; spider; bolts; adjustments.

Unit A. R. 13 *General Repairs on Universal Joint (Spicer, Hartford, etc.)* Replacing bushings; adjustments; lubrication.

Unit A. R. 14 *General Repairs to Flexible Fabric Disc Type of Universal.* Replacing discs.

Steering Mechanism

Unit A. R. 15 *General Repairs and Adjustments.* Worm and sector; thrust bearings; steering post and tube; spark and throttle controls.

Engine

Unit A. R. 16 *Repairs to L Head, Poppet Valve, Motor.* Grind valves; replace gaskets; fan belt; clean spark plugs.

Lubrication

Unit A. R. 17 *General Lubrication (grease).* Grease cups; front wheels; springs; universal joint; differential; transmission; steering gear.

Unit A. R. 18 *Crank Case Lubrication (motor oil).* Cleaning crank case; refilling; filter screen; inspection of oil flow.

Unit A. R. 19 *General Lubrication (motor oil).* Starting motor; generator; distributor; clutch; thrust bearing; Bendix drive; brake action; clutch pedal; accelerator, etc.

Unit A. R. 20 *Repairs to Lubricating System.* Oil pump; oil pipes; oil gauge; sight feed; pressure mechanism.

Cooling System

Unit A. R. 21 *General Repairs to System.* Hose; leak tests; assembling and placing radiator.

Fuel System

Unit A. R. 22 *Cleaning and Repairing.* Screen; tank; fuel gauge; "gas" line.

Lighting

Unit A. R. 23 *Simple Tests, Replacements and Adjustments.* Fuses; connections; broken lights; focus lights; test for shorts; armored cable repair; switch connections.

Horn

Unit A. R. 24 *Simple Repair to Horn.* Replacing horn; replacing or repairing horn button.

Battery

Unit A. R. 25 *Ordinary Service to Battery.* Specific gravity; water; clean terminals; install hold downs; remove and replace.

Second Division

Transmission

Unit A. R. 26 *Replacements and Adjustments in Selective Type.* Low; intermediate; high; reverse; counter shaft; bearings; shifting fingers; shafts; shift lever.

Unit A. R. 27 *Replacements and Adjustments in Planetary Type.* Triple gears; bushings; clutch disc; transmission bands.

Rear Axle

Unit A. R. 28 *Repairs and Replacements to Full Floating Type.* Ring gear; spider gear; axle and bearing.

Unit A. R. 29 *Repairs and Replacements to 3/4 and Semi-Floating types.* Spider gears; spider; axle and bearings; differential gear pinion and ring gear.

Unit A. R. 30 *Repairs to Internal Type Rear Axle.* Spur gear pinion; drive shaft; pinion and ring gears; internal gear.

Unit A. R. 31 *General Repairs to Worm Drive.* Worm gear; differential; thrust bearings; axle bearings.

Engine

Unit A. R. 32 *Adjustments and Replacements above Crank Case.* Valves; ignition points; timing gears.

Unit A. R. 33 *Repairs and Adjustments in the Crank Case.* Gaskets; connecting rod lower bearings; main bearings; cam shaft bearings; fly wheel.

Unit A. R. 34 *Piston Repair.* Rings; wrist pins and bearings.

Cooling System

Unit A. R. 35 *Radiator Repair.* Tank; tubes; connections.

Unit A. R. 36 *Water Pump Repair.* Impeller; gaskets; packing; thermostatic control.

Unit A. R. 37 *Vacuum Tank Repair.* Discharge valves; atmospheric and vacuum valves; screen; float; gaskets; control mechanism.

Carburetor

Unit A. R. 38 *Repairs and Adjustments to Common Types.* General cleaning; adjust float; grind float valve; nozzle; idling tube and throttle; auxiliary air valve; repair float.

Lighting

Unit A. R. 39 *Complex Adjustment & Repair.* Light plugs; dimmer resistance; switch contacts; ammeter; battery leads; circuit breaker.

Horn

Unit A. R. 40 *Repairs to Horn.* Vibrator; diaphragm; commutator; brushes; tests for shorts; new circuit.

Battery

Unit A. R. 41 *Tests on Batteries and Adjustments.* Discharge; capacity; cadmium tests; adjust sp. gr. of electrolyte.

Unit A. R. 42 *Internal Repairs to Battery.* Taking down; separation; plates; jar; resealing; terminals.

Starting System

Unit A. R. 43 *Simple Jobs & Testing.* Current and voltage at break away; starter circuit connections; starter switch; cable; Bendix drive; cleaning and oiling.

Unit A. R. 44 *Starting Motor, Repair and Adjustment.* Brushes; bearings; armature; field coil; commutator.

Generators

Unit A. R. 45 *Simple Tests in Place.* Voltage and charging rate; third brush and relay regulator adjustment.

Unit A. R. 46 *Common Shop Tests & Repair Jobs.* Brushes; commutator; removing generator; bearings; armature; field coil; commutator.

Ignition (battery)

Unit A. R. 47 *Simple Repair.* High tension cable; distributor block; coil; resistance unit; ignition lead; connections.

Unit A. R. 48 *More Complicated Repair.* Breaker points; contact screw and arm; breaker cam; time ignition.

Unit A. R. 49 *Atwater-Kent Repair.* Snapper; pivot contact arm; contact spring and screw; distributor block; breaker.

Ignition (magneto)

Unit A. R. 50 *Ford Ignition Repair.* Magnets and magnet coils; ignition wiring; commutator; vibrator.

Unit A. R. 51 *High Tension Magneto Repair.* Magnets; armature; collector ring; ground brush; bearings; breaker disc; contact screws; make and break lever; contact adjustments.

B. *Shop work in mechanical drafting.*

First Division

Introductory Principles

Unit M. Dr. 1 *Reading Drawings of and Sketching Simple Shapes.* Parallel faces; oblique surfaces; square and round faces and holes; hidden edges; dimensions.

Unit M. Dr. 2 *Geometrical Construction and Use of Instruments.* Bisecting lines and angles; transferring lines and angles; constructing triangles, quadrilaterals, polygons, inscribed in and circumscribed about a circle; application to practical drawings; lettering and plain title.

Unit M. Dr. 3 *Single View Representations.* Various types of threads with dimensions; pencil and ink, including relative width of lines.

Unit M. Dr. 4 *Drawings of Two Views.* Bolts; nuts; machine screws; set screws; keys; tapers; calculations; dimensions; full size scale; pencil and ink.

Machine Drafting Involving Straight Lines, Circles, Tangents

Unit M. Dr. 5 *Sketching and Drawing Requiring Decision on Views, Scale, Measurements and Dimension Lines.* Simple machine parts of one piece; parts of two or more pieces; detail and assembly drawings in pencil; title design.

Unit M. Dr. 6 *Tracing and Blue Printing.* Details and assembly drawings previously made.

Unit M. Dr. 7 *Conventional Representations Used in Drafting.* Drawings and tracings of machines and machine parts to include representation of cross section; cross hatching; screw threads; tapped holes; finish marks; drill sizes; tap sizes; thread sizes; etc.

Isometric Sketching and Drawing

Unit M. Dr. 8 *Isometric Sketches.* Making isometric sketches of simple machine parts.

Unit M. Dr. 9 *Isometric Drawings.* Making isometric drawings of simple machine parts.

Complex Machine Drafting

Unit M. Dr. 10 *Detail Drawings of simple Machine Parts.* Curved tangent lines; spacing; development of special curves; dividing and graduating.

Unit M. Dr. 11 *Developing Involved Cross Sections.* Cutting plane on center of symmetry; auxiliary cutting plane; half sections; combined section and full view.

Unit M. Dr. 12 *Transfer Drawing.* Detailing from assemblies; assembly from detail.

Unit M. Dr. 13 *Projections of Intersections.* Cylinders with axes at right and oblique angles; plane surface with cylinder or bell shaped surface.

Unit M. Dr. 14 *Projections of Irregular Parts.* Projections involving right and oblique auxiliary planes.

Unit M. Dr. 15 *Developments.* Cylindrical, conical, and irregular surfaces.

Unit M. Dr. 16 *Advanced Shop Sketching.* Simple machines of several parts; additional and altered parts to machine.

Unit M. Dr. 17 *Drafting Room Practice.* Filing; inventory; care of materials and equipment.

Second Division

Elementary Machine Design

Unit M. Dr. 18 *Belt Drive Layouts.* Direct drive and quarter turn; cross belt drive.

Unit M. Dr. 19 *Chain Drive.* Line chain and sprocket wheel; silent chain.

Unit M. Dr. 20 *Gear Design.* Involute and cycloidal gears; spur gears; bevel gears; worm and worm gears; spiral gears.

Unit M. Dr. 21 *Cam Curves and Cams.* Uniform and harmonic motion diagrams; plate cams; face cams; drum or cylinder cams.

Unit M. Dr. 22 *Miscellaneous Mechanical Movements.* Crank; eccentric; intermittent motion; pawl and ratchet; intermittent gearing; stop motion mechanism.

Unit M. Dr. 23 *Valve Gears.* Valve mechanisms; reversing mechanisms; floating gears.

Unit M. Dr. 24 *Complex Motions.* Cam and link.

Unit M. Dr. 25 *Clutch Mechanisms.* Friction; postive.

Unit M. Dr. 26 *Friction Drives.* Variable speeds; constant speed.

Unit M. Dr. 27 *Brake Mechanisms.*

Advanced Design

Unit M. Dr. 28 *Original Machine Design.* Determination of scale; layout from original data; materials for machines; principles involved in design; functions of mechanism; proper strength and proportion of parts.

Unit M. Dr. 29 *Tool Design.* Standard tools; special tools.

Unit M. Dr. 30 *Jigs and Fixtures.* Standard jobs; special jobs.

Special Drafting

Unit M. Dr. 31 *Structural Drafting.* Structural shapes; details of standard rivets; bolts, clevises, fastenings, anchors, etc.; layouts of standard frames.

Unit M. Dr. 32 *Electrical Drafting.* Switchboard and other wiring diagrams; electrical machinery; plant layout; standard conventions.

Unit M. Dr. 33 *Shop Layouts.* Machinery and equipment placement; power distribution.

Unit M. Dr. 34 *Patent Office Drawing.* Drawing and shading.

Unit M. Dr. 35 *Catalogue Drawing.*

Unit M. Dr. 36 *Drafting Room Management.* Material lists; casting and pattern lists; filing, recording and distributing drawings.

C. *Shop work in electrical wiring.* (All work to be taught in accordance with National Electrical Code.)

First Division

Bells and Annunciators

Unit 1 *Bell Circuits.* Wiring with push buttons, floor push and door push; one bell and two buttons; one bell and three buttons; two bells and one button; two bells and two buttons—both bells ring.

Unit 2 *Bells and Annunciators (advanced work).* Bell circuits with two bells and two buttons, three bells and three buttons—one button controls one bell; return call circuits with two bells and two buttons—two and three wires; return call circuits, four bells and four buttons; wiring four point annunciator.

Unit 3 *Burglar Alarm.* Burglar alarm with open circuit system.

Unit 4 *Burglar Alarm.* Burglar alarm with closed circuit system.

Wiring for Light and Power

Unit 5 *Open or Exposed Wiring.* Snap switches, single pole, double pole, three way, four way, and electrolier switches to be used.

Unit 6 *Concealed Knob and Tube Wiring.* Snap or flush switches of types indicated in Unit 5.

Unit 7 *Molding Wiring (metal and wood.)* Snap switches of types indicated in Unit 5.

Unit 8 *Method of Wiring for Light (series circuits).*

Unit 9 *Series Circuits in Parallel and Parallel Circuits in Series.*

Fixture Wiring and Installation

Unit 10 *Single Light Fixtures with Crowfeet.*

Unit 11 *Single Light Fixtures with Insulating Joint.*

Unit 12 *Two or More Cluster Light Fixtures.*

Unit 13 *Installation of Combination Fixtures.*

Unit 14 *Changing Gas Fixtures to Electric Fixtures.*

Wiring for Direct Current Motors (Open Work)

Unit 15 *Wiring for and Connecting Series, Shunt and Compound Motors without Starting Box.*

Unit 16 *Wiring for and Connecting Series, Shunt, and Compound Motors with Starting Boxes, Various Types.*

Unit 17 *Wiring for and Connecting Series, Shunt, and Compound Motors with Speed Controller.*

Wiring for Alternating Current Motors (Open Work)

Unit 18 *Wiring for and Connecting Single, Two and Three Phase Induction Motors with Safety Switch.*

Second Division

Advanced Wiring for Light and Power

Unit 19 *Rigid Conduit Wiring.* Flush switches, single pole, double pole, three way, four way, and electrolier switches to be used.

Unit 20 *Flexible Conduit and Armored Cable Wiring.* Flush switches of types indicated in Unit 19 to be used.

Unit 21 *Service and Meter Installation.*

Unit 22 *Installation Requiring Panel Board—Two and Three Circuits.*

Unit 23 *Theater Wiring.*
Unit 24 *Wiring Buildings of Mill Construction.*
Unit 25 *Miscellaneous Wiring.*

Fixture Wiring and Installation

Unit 26 *Installing Fixtures on Conduit and Armored Cable, Concealed and Exposed Work.*
Unit 27 *Installing Wall Brackets on Concealed Knob and Tube Wiring, with and without Canopy Switches.*

Interior Telephone Wiring

Unit 28 *Wiring for Two Telephones with One and Two Sets of Batteries.*
Unit 29 *Wiring for Two Magneto Telephones.*
Unit 30 *Wiring for Intercommunicating Telephones.*

Radio

Unit 31 *Wiring a Receiving Set.*
Unit 32 *Wiring a Sending Set.*

Direct Current Motors (Conduit and Armored Cable)

Unit 33 *Installing and Reversing Series, Shunt and Compound Motors.*
Unit 34 *Wiring for Remote Control of Shunt, Series and Compound Motors.*

Alternating Current Motors (Conduit and Armored Cable)

Unit 35 *Wiring for Two or Three Phase Compensators.*
Unit 36 *Wiring for Motors with Remote Control Buttons.*
Unit 37 *Wiring for Other Types of Motor.*

Repairs

Unit 38 *Miscellaneous Repairs to D. C. and A. C. Machines.*
Unit 39 *Miscellaneous Repairs to Control Apparatus.*

D. *Shop work in electrical operating and testing.*

First Division

Simple D. C. Measurements and Testing

Unit 1 *Speed Indicating on Motors with Speed Indicators.*
Unit 2 *Fuses.* Testing and refilling.
Unit 3 *D. C. Measurements.* Ammeter; voltmeter; wattmeter; M. V. meter and shunt.

Batteries

Unit 4 *Primary Batteries.* No-load tests; load tests; life tests.
Unit 5 *Storage Batteries.* Gravity tests; no-load tests; capacity tests; charging.

Unit 6 *Trouble Shooting in Simple Circuits.* Magneto; bell and battery; test lamp.

Tests and Measurements on Conductors

Unit 7 *Measurement of Resistances.* Slide wire bridge; wheatstone bridge; ammeter-voltmeter method; voltmeter method.

Unit 8 *Wires.* Test sizes and insulations; calculations from sizes; mill-feet calculations; comparative tests on wires of different material.

Unit 9 *Trouble Shooting on Involved Circuits.* Light circuits; switch board circuits.

Unit 10 *Circuit Calculations (D. C.)* Current in series and parallel connections; voltage in series and parallel connections; resistance in series and parallel connections.

Electro Magnetic Induction

Unit 11 *Self Induction.* Spark coils; field windings.

Unit 12 *Mutual Induction.* Spark coils; induction coils; induction in adjacent circuits.

Condensers

Unit 13 *Condensers.* Construction and use.

D. C. Motors

Unit 14 *Electro Magnets.* Saturation and attraction test.

Unit 15 *D. C. Motors.* Name of parts; types and general characteristics; operation; control.

Unit 16 *Brushes.* Current carrying capacity; wearing qualities, and fit.

Unit 17 *D. C. Motor Inspection.* Condition of bearings, commutator and brushes; insulation; resistance.

Unit 18 *Armature Tests.* Open circuits; shorts; grounds.

Unit 19 *D. C. Motor Tests (various types).* Speed characteristics; load tests; efficiency tests.

Unit 20 *Trouble Shooting on D. C. Motors.* Troubles and remedies.

D. C. Appliances

Unit 21 *D. C. Motors.* Repair; calibration.

Unit 22 *Circuit Breakers.* Adjusting; calibrating.

D. C. Generators

Unit 23 *General Study.* Comparison with motor; types and general characteristics; operation; control; parallel operation; three wire generators.

Unit 24 *Trouble Shooting on D. C. Generators.* Troubles and remedies.

Unit 25 *D. C. Generator Tests.* Field saturation test; load test; efficiency test; temperature test.

Lighting

Unit 26 *Incandescent Lamps.* Types; characteristics; cold and hot resistance; efficiencies.

D. C. Power Plant and Sub-station Work

Unit 27 *Station Operation.*

Second Division

Introduction to A. C. Circuits

Unit 28 *Comparison of D. C. with A. C. Single and Polyphase Circuits.*

Unit 29 *A. C. Measurements.* Impedance; inductance; reactance.

Unit 30 *Voltage and Current Relations in Polyphase Circuits. Rectifiers. Operation and Efficiency.* Vibrating; mercury arc; tungar.

A. C. Motors

Unit 32 *A. C. Motors.* Names of parts; types and general characteristics; operation; compensators and slipring control.

Unit 33 *A. C. Motor Inspection.* Condition of mechanical parts; insulation resistance.

Unit 34 *A. C. Motor Tests (various types).* Speed characteristics; reversal of rotation; load tests; efficiency tests.

Unit 35 *Trouble Shooting on A. C. Motors.*

A. C. Appliances

Unit 36 *A. C. Meters.* Repair, calibration.

Unit 37 *Special Meter Tests.* Watt-hour meter; demand meter.

Unit 38 *Operation of and Test on Special A. C. Appliances.* Circuit breakers; lightning arresters; oil switches; overload, under voltage, time limit and reverse current relays.

A. C. Generators

Unit 39 *Alternators.* Types; operation; general characteristics; control; parallel operation.

Unit 40 *Trouble Shooting on Alternators.* Troubles and their remedies.

Unit 41 *Rotary Converter.* Operation; efficiency test.

Unit 42 *Operation of Alternator as Synchronous Motor.*

Transformers

Unit 43 *Transformers.* Voltage relations; connections; testing.

Unit 44 *Meter Transformers.* Current; potential.

Plant Operation

Unit 45 *A. C. Power Plant Operation.*

Unit 46 *A. C. Sub-stations.*

Miscellaneous

Unit 47 *Special Tests.*

Unit 48 *Power Transmission.* Systems; calculations.

Unit 49 *Estimating Costs of Operation of Electrical Appliances.*

Unit 50 *Illumination.* Principles; measurement of foot candle illumination; tests on reflectors; street lighting.

Unit 51 *Telephones.* Line tests; plant tests.

Unit 52 *Electroplating.*

Unit 53 *Radio Telegraphy and Radio Telephony.*

E. *Shop work in machine shop practice.*

First Division

Lathe Work

Unit Mach. 1 *Straight Turning on Centers.*

Unit Mach. 2. *Straight Turning on Mandrels.*

Unit Mach. 3 *Drilling.*

Unit Mach. 4 *Boring.*

Unit Mach. 5 *Reaming.*

Unit Mach. 6 *External Threading.*

Unit Mach. 7 *Taper Turning.*

Unit Mach. 8 *Grinding Tools.*

Drill Press Operations

Unit Mach. 9 *Rough Drilling.*

Unit Mach. 10 *Drilling to Layout.*

Unit Mach. 11 *Reaming.*

Unit Mach. 12 *Counterboring.*

Unit Mach. 13 *Drilling in Vise.*

Unit Mach. 14 *Tool Grinding.*

Shaper Work

Unit Mach. 15 *Flat Surfaces, More than One Side.*

Unit Mach. 16 *Cutting Grooves.*

Unit Mach. 17 *Taper Work.*

Unit Mach. 18 *Cutting Keyways.*

Unit Mach. 19 *Tool Dressing and Grinding.*

Milling Machine Operation

Unit Mach. 20 *Plain Milling.*
Unit Mach. 21 *End Milling.*
Unit Mach. 22 *Vertical Milling.*
Unit Mach. 23 *Taper Milling.*
Unit Mach. 24 *Drilling.*
Unit Mach. 25 *Counterboring.*
Unit Mach. 26 *Reaming.*
Unit Mach. 27 *Plain Indexing.*

Universal Grinder

Unit Mach. 28 *Grinding Plane Surfaces.*
Unit Mach. 29 *Grinding Straight Cylinder.*
Unit Mach. 30 *Grinding Tools.*

Hack Saw Work

Unit Mach. 31 *Rough Sawing.*
Unit Mach. 32 *Cutting to Dimensions.*

Bench and Floor Work

Unit Mach. 33 *Rough Chipping and Chipping to Line.*
Unit Mach. 34 *Rough Filing and Filing to Line.*
Unit Mach. 35 *Filing Thin Stock.*
Unit Mach. 36 *Scraping Flat Surfaces.*
Unit Mach. 37 *Riveting.*
Unit Mach. 38 *Drilling with Hand and Breast Drill.*
Unit Mach. 39 *Hand Sawing.*
Unit Mach. 40 *Tapping.*
Unit Mach. 41 *Assembling (helper).*

Forge Work

Unit Mach. 42 *Tempering and Hardening.*
Unit Mach. 43 *Drawing Down Chisels.*
Unit Mach. 44 *Bending Lathe Tools.*
Unit Mach. 45 *Upsetting Bolts and Lathe Tools.*
Unit Mach. 46 *Splitting and Punching Lathe Dog.*

Second Division

Lathe Work

Unit Mach. 47 *Facing.*
Unit Mach. 48 *Chucking.*
Unit Mach. 49 *Recentering.*
Unit Mach. 50 *Knurling.*
Unit Mach. 51 *Crowning.*
Unit Mach. 52 *Internal Threading.*
Unit Mach. 53 *Parting.*
Unit Mach. 54 *Driving, Shrink, Tapered and Running Fit.*

Unit Mach. 55 *Chamfering.*
Unit Mach. 56 *Angular Turning.*
Unit Mach. 57 *Countersinking.*
Unit Mach. 58 *Straightening.*
Unit Mach. 59 *Steady Rest Work.*
Unit Mach. 60 *Follow Rest Work.*
Unit Mach. 61 *Spring Winding.*
Unit Mach. 62 *Grooving.*
Unit Mach. 63 *Forming.*

Drill Press Operations

Unit Mach. 64 *Tapping, Right and Left Hand.*
Unit Mach. 65 *Countersinking.*
Unit Mach. 66 *Drilling with Plate Jig.*
Unit Mach. 67 *Drilling with Angle Plate.*

Shaper Work

Unit Mach. 68 *Shaping T-slots.*
Unit Mach. 69 *Dovetailing.*
Unit Mach. 70 *Slotting.*
Unit Mach. 71 *Shaping on Centers.*
Unit Mach. 72 *Irregular Curves.*
Unit Mach. 73 *Down Cutting.*
Unit Mach. 74 *Under Cutting.*

Planer Work

Unit Mach. 75 *Planing One Horizontal Surface.*
Unit Mach. 76 *Planning a Job to Layout Two or More Faces.*

Milling Machine Operations.

Unit Mach. 77 *Cam Milling.*
Unit Mach. 78 *Back Milling.*
Unit Mach. 79 *Keyway Cutting.*
Unit Mach. 80 *Worm Gear and Wheel.*
Unit Mach. 81 *Bevel, Spiral and Spur Gears.*
Unit Mach. 82 *Reamer and Tap Fluting.*
Unit Mach. 83 *Cutter Toothing.*
Unit Mach. 84 *Slab Milling.*
Unit Mach. 85 *Compound and Differential Indexing.*
Unit Mach. 86 *Straddle Milling.*
Unit Mach. 87 *Slotting.*
Unit Mach. 88 *Boring.*
Unit Mach. 89 *Fly Cutting.*
Unit Mach. 90 *T-slot Cutting.*
Unit Mach. 91 *Gang Milling.*
Unit Mach. 92 *Hobbing.*
Unit Mach. 93 *Graduating.*

Universal Grinder

Unit Mach. 94 *Outside and Inside Taper Grinding.*
Unit Mach. 95 *Cutter Grinding.*
Unit Mach. 96 *Thread Tool Grinding.*
Unit Mach. 97 *Chuck Work.*
Unit Mach. 98 *Reamer Grinding.*
Unit Mach. 99 *Backing Off.*

Bench and Floor Work

Unit Mach. 100 *Reaming.*
Unit Mach. 101 *Fitting Keys.*
Unit Mach. 102 *Babbitting and Scraping Bearings.*
Unit Mach. 103 *Scraping and Spotting.*
Unit Mach. 104 *Squaring Up.*
Unit Mach. 105 *Belt Lacing.*
Unit Mach. 106 *Oiling and Adjusting Machinery.*
Unit Mach. 107 *Assembling.*

Forging

Unit Mach. 108 *Welding.*
Unit Mach. 109 *Hardening and Tempering.*
Unit Mach. 110 *Tool Making.*

F. *Shop work in patternmaking.*

First Division

Patterns of Solid Construction

Unit Pat. 1 *One Piece Patterns.*
Unit Pat. 2 *Patterns of Assembled Formed Parts.*
Unit Pat. 3 *Green Sand Core Patterns.*
Unit Pat. 4 *Moulding Patterns of This Class.*

Split Patterns

Unit Pat. 5 *Patterns with Straight Partings.*
Unit Pat. 6 *Patterns with Irregular Partings.*
Unit Pat. 7 *Patterns with Two or More Partings.*
Unit Pat. 8 *Patterns with Loose Pieces.*
Unit Pat. 9 *Moulding Patterns of This Class.*

Pattern Turning

Unit Pat. 10 *Straight Spindle Turning.*
Unit Pat. 11 *Tapered Spindle Turning.*
Unit Pat. 12 *Stepped and Shouldered Spindle Turning.*
Unit Pat. 13 *Spindle Turning to Template.*
Unit Pat. 14 *Cup Chuck Turning.*
Unit Pat. 15 *Screw Chuck Turning.*

Unit Pat. 16 *Face Plate Turning.*
Unit Pat. 17 *Eccentric Face Plate Turning.*
Unit Pat. 18 *Recess Chucking.*
Unit Pat. 19 *Segment Rechucking.*
Unit Pat. 20 *Moulding Patterns of This Block.*

Second Division

Dry Sand Core Patterns

Unit Pat. 21 *Pattern with Cope and Drag Core Prints.*
Unit Pat. 22 *Pattern with Parallel Core Prints.*
Unit Pat. 23 *Pattern with Balanced Core Prints.*
Unit Pat. 24 *Pattern with Pocket Core Prints.*

Core Box Construction

Unit Pat. 25 *Square or Rectangular Boxes.*
Unit Pat. 26 *Square or Rectangular Boxes with Fillets.*
Unit Pat. 27 *Round and Half Round Boxes.*
Unit Pat. 28 *Chamfered and Offset Boxes.*
Unit Pat. 29 *Right and Left Hand Boxes.*
Unit Pat. 30 *Boxes Fitted with Interchangeable Parts and Stop Off Pieces.*
Unit Pat. 31 *Sectional Boxes.*
Unit Pat. 32 *Cores Partly Formed by Stickles.*
Unit Pat. 33 *Coremaking and Moulding.*

Built-up Patterns

Unit Pat. 34 *Brackets, Frame and Ribbed Plate Work.*
Unit Pat. 35 *Flanged Plate Work.*
Unit Pat. 36 *Circular Segment Pattern.*
Unit Pat. 37 *Segment Work with Curved Bed and Ribs.*
Unit Pat. 38 *Flanged Segment Patterns.*
Unit Pat. 39 *Straight Boxing.*
Unit Pat. 40 *Tapered Boxing.*
Unit Pat. 41 *Solid Stepped Patterns.*
Unit Pat. 42 *Stepped Patterns on Heads.*
Unit Pat. 43 *Internal Staving or Lagging.*
Unit Pat. 44 *External Staving or Lagging.*

Wheels, Pulleys and Sheaves.

Unit Pat. 45 *Web Work.*
Unit Pat. 46 *Arm Patterns.*
Unit Pat. 47 *Flanged Work.*
Unit. Pat. 48 *Patterns with Electric Hubs and Bosses.*
Unit Pat. 49 *Counterbalanced Wheels.*

G. *Shop work in printing.*

First Division

Elementary Composition

Unit Pr. 1 *Type Cases.* Learning the case; using the composing stick; justification spacing; emptying the stick.

Unit Pr. 2 *Distribution.* Distributing type; caring for materials.

Unit Pr. 3 *Pulling and Correcting Proof.* Tying up; taking planer proofs; marking proofs; errors; correcting errors; using proof press.

Unit Pr. 4 *Styles of Composition.* Caps and small caps; punctuation—period and comma; division of words; indention; setting poetry; leader and figure work; the point system; double justification.

Job Composition

Unit Pr. 5 *Elements of Job Composition.* Type faces and materials; spacing between words; styles of job composition; job distribution.

Unit Pr. 6 *Small Commercial Forms.* Envelopes; letterheads; billheads and statements; shipping tags and labels; handbills.

Unit Pr. 7 *Society forms.* Name cards.

Stone Work

Unit Pr. 8 *Elements of Lock-up.* Lock-up equipment; principles of lock-up; making proofs and corrections; locking-up small forms.

Job Press

Unit Pr. 9 *Job Press Feeding.* Getting acquainted with the press; oiling and cleaning; feeding blank stock; feeding live jobs; washing the press.

Unit Pr. 10 *Press Preparation.* Preparing the tympan; inking-up; placing the form; getting uniform impression; press O. K.

Pamphlet Binding

Unit Pr. 11 *Cutting.* Receiving and handling stock; cutting stock.

Unit Pr. 12 *Folding.* Hand folding.

Unit Pr. 13 *Stitching and Trimming.* Gathering; wire stitching.

Unit Pr. 14 *Finishing Operations.* Punching; perforating; padding.

Second Division

Book Composition

Unit Pr. 15 *Book Faces.* Characteristics; the book font; type size.

Unit Pr. 16 *Book Pages.* Proportion; page spacing and justification; analysis of copy; caps, small caps and italics.

Unit Pr. 17 *Headings, Folios and Initials.* Initials; running heads and folios; chapter headings.

Unit Pr. 18 *Notes and References.* Extracts; foot notes; marginal notes.

Advertising Composition

Unit Pr. 19 *Principles of Display.* Lines and masses; varying degrees of emphasis; contrast; harmony; proportion; balance; spacing.

Unit Pr. 20 *Selection of Type and Materials.* Classifying type faces; type families and series; expressing thought with type; initial letters; printers' rules; borders and ornaments.

Job Composition

Unit Pr. 21 *Elements of Job Composition.* Letter spacing; breaking forms for color.

Unit Pr. 22 *Small Commercial Forms.* Business cards; receipts; banking forms; blotters; legal forms; calendars; holiday printing.

Unit Pr. 23 *Society Forms.* At home cards; society stationery; announcements; wedding invitations.

Unit Pr. 24 *Booklets and Folders.* Connection with book printing; four-page programs; menus.

Stone Work

Unit Pr. 25 *Elements of Lock-up.* Locking-up rule forms; locking-up for foundry; registering color forms.

Unit Pr. 26 *Imposition.* Four-page forms; eight-page forms; margins; work-and-turn forms; sheetwise forms.

Job Press

Unit Pr. 27 *Press Preparation.* Make-ready for wood base electro-types; make-ready for mixed forms; make-ready for rule form.

Unit Pr. 28 *Press Adjustment and Mechanism.* Platen adjustments; press motions; inking system.

Unit Pr. 29 *Half Tone Make-ready.* Square half tone; tint block; ink distribution.

Unit Pr. 30 *Special Press Operations.* Perforating; scoring; numbering; bronzing.

Cylinder Press

Unit Pr. 31 *Cylinder Press Feeding.* Getting acquainted with the press; oiling and cleaning; feeding blank stock; feeding live jobs; washing up.

Unit Pr. 32 *Press Preparation.* Preparing the tympan; inking the press; setting guides.

Pamphlet Binding

Unit Pr. 33 *Cutting.* Receiving and handling stock; cutting stock.

Unit Pr. 34 *Folding.* Machine folding; types and uses of folders.

Unit Pr. 35 *Stitching and Trimming.* Sewing; attaching, covers; trimming.

Unit Pr. 36 *Finishing Operations.* Inspecting and packing.

Unit Pr. 37 *Folding Machine Adjustment.* Oiling and cleaning; machine changes; guides; right angle and oblong folds; parallel fold; scoring and perforating; slitting and delivering; special folds.

Unit Pr. 38 *Cutting Machine Adjustment.* Oiling and cleaning; gauges and clamp; knife control and adjustment.

Unit Pr. 39 *Wire Stitcher Adjustment.* Oiling and cleaning; setting; stitcher mechanism.

Linotype

(Elective)

Unit Pr. 40 *Keyboard Practice.* Keyboard layout; keyboard action; word practice; sentence practice; general keyboard practice.

Unit Pr. 41 *Straight Matter Composition.* Mechanical details; operation of live keyboard; spacing and justification; setting various styles; care of machine; care of metal.

Unit Pr. 42 *Mechanism.* Keyboard construction; magazine escapement; magazine; distributor; metal pot; gas burner; temperature governor; pressure governor.

Third Division

Book Composition

Unit Pr. 43 *Preface Matter and Index.* Copyright and imprint; dedication; table of contents; preface and introduction; index.

Unit Pr. 44 *Title Pages.* Sketching of arrangements; selection of type; borders and ornaments.

Unit Pr. 45 *Paging and Make-up.* Make-up materials; paging; make-up; illustrations and tables; proofing and storing.

Tabular Composition

Unit Pr. 46 *Casting Up Tables.* Tables without rules; tables with rules; justifying a table; box headings; registering to rule sheets; tariffs and time tables.

Advertising Composition

Unit Pr. 47 *Analysis of Copy.* Atmosphere; salient points; subordinate information.

Unit Pr. 48 *Newspaper Advertisements.* Measures and dimensions; featuring prices; methods of composition; single and multiple column advertisements; department store advertisements.

Unit Pr. 49 *Magazine Advertisements.* Possibilities and limitations; placing illustrations; harmonizing type with illustrations; mail order advertisements.

Unit Pr. 50 *Layouts and Specifications.* Preliminary sketches; working to layout; determining type sizes and measures; marking up copy.

Job Composition

Unit Pr. 51 *Religious Printing.* Ecclesiastical stationery; church programs.

Unit Pr. 52 *Booklets and Folders.* Cover pages; text pages; folios; special fold arrangement.

Unit Pr. 53 *Catalogs.* Catalog covers; title pages; introductory matter, placing of illustrations; tabular matter in catalog pages; make-up of pages; copy fitting.

Stone Work

Unit Pr. 54 *Imposition.* Twelve-page forms; sixteen-page forms; twenty-four-page forms.

Job Press

Unit Pr. 55 *Half Tone Make-ready.* Vignette; process color.

Unit Pr. 56 *Special Press Operation.* Embossing.

Unit Pr. 57 *Automatic Feeders.* Gauges and sheet adjusters; grippers and delivery fingers; air feed mechanism; feed and delivery boards; minor adjustments; envelope and card attachments.

Cylinder Press

Unit Pr. 58 *Make-ready.* Placing the form; underlaying; registering and position O. K.; type forms; wood base, electros; mixed forms.

Unit Pr. 59 *Minor Adjustments.* Sheet control; gripper motion; sheet delivery; fountain.

Unit Pr. 60 *Make-ready for Engraving.* Line plate and Ben Day; square half tones; color type forms; vignette; duotone; process color.

Unit Pr. 61 *Press Rollers.* Composition; adjustment; care and seasoning; ordering.

Unit Pr. 62 *Printing Ink.* Qualities of ink; ink on paper.

Unit Pr. 63 *Press Mechanism.* Bed motion; cylinder adjustments; air cushions.

Unit Pr. 64 *Mechanical Overlays.* Preparing press to make overlay; impression; relieving high lights; final processes.

Unit Pr. 65 *Plates and Bases.* Laying and clamping book plates; clamping and registering color plates; interlaying; uses of plates and bases.

Unit Pr. 66 *Automatic Feeders.* Loading stock; feeding mechanism; calipers, tapes and guards; trips and sheet guides.

Unit Pr. 67 *Color.* Base color selection; mixing and matching; color modifications.

Linotype

(Elective)

Unit Pr. 68 *Intricate Composition.* Twin slug composition; broken measure; borders and dashes; advertising; price list; sports and markets; statistical and classified; two line figures; panel; newspaper headings; program and poetry; folios and book headings; directory and mailing list; signs and symbols.

Unit Pr. 69 *Mechanism.* Distributor box; assembler plate; assembling elevator; assembler slide; space band box; dissembling; driving shaft and clutch; automatic stopping pawls; controlling lever; automatic and safety pawls; cams; mold discs; justification; vise automatic; first elevator; line carriage; the transfer; second elevator; trimming knives; metal pot; gas burner; temperature governor; pressure governor.

H. *Shop work in sheet metal working.* Students should become familiar with the following operations of sheet metal working practice. The course outlined is designed to give experience in these operations and a well-rounded experience in sheet metal production.

1 Assembling
2 Approximate pattern method
3 Beading
4 Bending
5 Hand shears "cutting"
6 Square shears "cutting"
7 Stock shears "cutting"
8 Crimping and beading
9 Cornice brake
10 Cleaning
11 Developing patterns
12 Drawing
13 Doubleseaming
14 Drilling
15 Dressing flanges
16 Doubleseaming corners
17 Edging with burring machine
18 Edging with turning machine
19 Edging by hand
20 Edging with bar folder
21 Edging for wire
22 Folding in bar folder
23 Folding in cornice brake
24 Grooving by hand
25 Grooving by machine
26 Hack sawing
27 Inside miter
28 Laying out simple patterns
29 Lapping seams at cornice
30 Layout pattern for solid cornice
31 Lapped seam
32 Marking out from pattern
33 Measuring with rule, square etc.
34 Making a hinged top
35 Making hinges
36 Making clasps
37 Marking out a circle
38 Notching
39 Nailing
40 Ogee bead
41 Outside miter
42 Punching with machine
43 Punching with hollow punch
44 Punching with solid punch
45 Peening edges
46 Panned corners
47 Parallel development
48 Projection
49 Riveting
50 Round articles
51 Radical development
52 Rectangular to round
53 Soldering
54 Soldering laps at corners
55 Soldering seams
56 Setting down edges
57 Triangulation
58 Three pieces
59 Tapering tube in center
60 Wiring in the straight
61 Wiring with machine

First Division

Tin Work

Unit S. M. 1 *Wall Match Box. (small size).* Laying out simple patterns.

Unit S. M. 2 *Wall Match Box. (large size).* Laying out simple patterns.

Unit S. M. 3 *Doughnut Cutter.* Laying out simple patterns.

Unit S. M. 4 *Measuring Cup.* Laying out simple patterns.

Unit S. M. 5 *Straight Bucket.* Laying out simple patterns.

Unit S. M. 6 *Tapered Bread Pan.* Laying out simple patterns.

Unit S. M. 7 *Tapered Cake Pan.* Mark out from patterns.

Unit S. M. 8 *Straight Quart with Lip.* Mark out from patterns.

Galvanized Iron Work

Unit S. M. 9 *Dust Pan, Band Iron Handle.* Laying out simple pattern.

Unit S. M. 10 *Grocer's Scoop.* Mark out from patterns.

Unit S. M. 11 *Six Inch Funnel.* Approximate method for patterns.

Pipe Work

Unit S. M. 12 *Three-Inch Stove Pipe.* Approximate method for patterns.

Unit S. M. 13 *Canopy Top on Smoke Stack.* Approximate method for patterns.

Unit S. M. 14 *Tee Pipe Joint.* Approximate method for patterns.

Unit S. M. 15 *Conductor Pipe Elbows.* Mark out from patterns.

Unit S. M. 16 *2" x 3" Hanging Gutter.* Make patterns.

Tin Work

Unit S. M. 17 *Raised Lid for Bucket.* Make patterns.

Unit S. M. 18 *Eight Inch Funnel.* Make patterns radial method.

Unit S. M. 19 *Tapering Quart Measure.* Make patterns radial method.

Unit S. M. 20 *Tapering Colander.* Make patterns radial method.

Unit S. M. 21 *Sink Strainer.* Make patterns radial method.

Galvanized Iron Work

Unit S. M. 22 *Flaring Pan.* Make patterns radial method.
Unit S. M. 23 *Water Bucket, 14 Quart.* Make pattern radial method.
Unit S. M. 24 *Roof, Flange 8/12 Pitch.* Make pattern parallel method.
Unit S. M. 25 *Tapering Roof Flange.* Make pattern triangulation method.
Unit S. M. 26 *Tee Joint at 90° Angle.* Make pattern parallel method.
Unit S. M. 27 *Tee Joint at 45° Angle.* Make pattern parallel method.
Unit S. M. 28 *Round Elbow, 3 Piece.* Make pattern parallel method.

Roof Work

Unit S. M. 29 *Fire Door.* Measure materials.
Unit S. M. 30 *Erection of Gutter and Conductor.* Measure materials.
Unit S. M. 31 *Roof Construction.* Measure materials.
Unit S. M. 32 *Hanging Gutter and 90° Miter.* Make pattern parallel method.
Unit S. M. 33 *Hanging Gutter and 60° Miter.* Make pattern parallel method.
Unit S. M. 34 *Tapering Eaves Pipe.* Make pattern radial method.

Repair Work

Unit S. M. 35 *Repairing Damaged Fender.*
Unit S. M. 36 *Repairing Damaged Radiator*
Unit S. M. 37 *Repairing Heavy Broken Parts.*

Second Division

Galvanized Iron Work

Unit S. M. 38 *Bread Box.* Make patterns.
Unit S. M. 39 *Washboiler No. 8 Size.* Make patterns.
Unit S. M. 40 *Washboiler Cover.* Make patterns radial method.
Unit S. M. 41 *Flour Can, Lid Attached.* Make patterns radial method.
Unit S. M. 42 *Garbage Can, 2 Bu.* Make patterns.
Unit S. M. 43 *Garbage Can Lid.* Make patterns radial method.
Unit S. M. 44 *Garbage Can Lid Detachable.* Make patterns.

Unit S. M. 45 *Winter Window Box.* Make patterns.
Unit S. M. 46 *Sprinkler Can.* Make patterns radial method.

Furnace Work

Unit S. M. 47 *Floor Register Box.* Make patterns by triangulation.
Unit S. M. 48 *Cold Air Boot.* Make patterns by triangulation.
Unit S. M. 49 *Collar for Furnace Hood.* Make patterns by parallel method.
Unit S. M. 50 *Coal Hod.* Make patterns by triangulation.

Copper Work

Unit S. M. 51 *Electric Boudoir Lamp.* Make pattern, projection method.
Unit S. M. 52 *Flower Vase.* Make pattern, projection method.
Unit S. M. 53 *Electric Floor Lamp.* Make pattern, projection method.
Unit S. M. 54 *Electric Toaster.*
Unit S. M. 55 *Humidor.*
Unit S. M. 56 *Picture Frame.*

Miscellaneous Work

Unit S. M. 57 *Ventilating System.* Make pattern by all methods.
Unit S. M. 58 *Skylights.* Make pattern by parallel method.
Unit S. M. 59 *Cornice Work.* Make pattern by projection method.

XVIII. SUBJECT MATTER FOR RELATED SUBJECTS

Typical Outlines of Subject Matter. Related subject courses are intended to increase the trade knowledge of the students. In view of this fact the instructional material should be very closely correlated to the shop work and the general requirements of the trade. The related subject group in general includes drawing, mathematics and science, and trade theory.

Material for study may be procured from texts, reference books, catalogues, graphs, charts or diagrams and by personal observations of and experiences with machines, tools and processes on the part of the students and teachers.

When presenting a related subject, it is rarely possible to use a text just as it is written. Any good text or texts may be used as the basis for selecting and planning fundamental instruction. It is desirable to have a small library of texts and reference books for the

teacher's use. Obsolete or burdensome processes, and subject matter that is not purposeful from the standpoint of related subject instruction should not be considered as part of the course.

The discussion which follows in regard to subject matter for related subjects is intended to indicate standards with suitable illustrations of working programs. The outlines of subject matter given are intended to represent typical examples only and do not cover all trades. Related subject courses for other trades may be planned in a similar manner to meet the specific trade requirements.

A. *Related Drawing.* The drawing taught in connection with trade courses may be mechanical drafting, architectural drafting or applied design depending upon the requirements of the trade.

The subject matter covered by a given student will lead to ability in the construction or interpretation of drawing in varying degrees, depending upon the needs of the trade.

Typical Drafting Course for Automobile Repairmen.

Unit 1 *Reading Drawings and Blue Prints.* Reading machine drawing as outlined for machinist course; reading chassis and wiring diagrams.

Unit 2 *Shop Sketching.* Freehand sketches of automobile parts; ordering from sketches; suitable lettering.

Unit 3 *Geometrical Construction.* Same type of work as outlined for machinists.

Unit 4 *Automobile Drafting.* Use of instruments in making mechanical drawings of parts previously sketched in unit 2; drawing chassis assembly, differential assembly, transmission assembly, carburettor assembly, engine assembly, complete ignition system, wiring system for lights, wiring system for charging.

Typical Architectural Drawing for Carpenters

Unit 1 *Reading Drawings.* Blue print reading, using house plans and elevations.

Unit 2 *Sketching.* Sketching plans, elevations and details; necessary architectural lettering.

Unit 3 *Geometrical Construction.* Problems such as are outlined for machinists; details of moulding and profiles; architectural lettering.

Unit 4 *Architectural Drafting.* Floor plans to include sizes and arrangement of rooms for a one, two, and three-story house; necessary lettering; architectural plan details, symbols, and conventions; development of elevations with lettering; architectural elevation details to include cornices, chimneys, windows, dormers, etc.

Unit 5 *Orders of Architecture.* Characteristics and proportions of the orders of architecture; details of Doric order.

Unit 6 *Writing Specifications.*

Unit 7 *Estimating Costs.*

Unit 8 *Elementary Mechanical Perspective.*

Typical Drafting Course for Electricians.

Unit 1 *Blue Print Reading.* Reading simple machine drawings, architectural plans, and simple wiring diagrams.

Unit 2 *Sketching.* Sketching simple circuits and plant arrangements.

Unit 3 *Electrical Conventions.* Use of instruments in drawing, conventional signs and symbols used in representing machines and instruments found in light and power installations, telephone work, telegraph work and wireless, including proper lettering.

Unit 4 *Wiring Diagrams.* Connection diagrams for various jobs done in shop.

Unit 5 *Electrical Drafting.* Use of instruments in drawing house plans, including small dwellings, small office building, power plant, lighting circuits, small motor installation, substation wiring, power plant wiring including switch and instrument board details, telephone circuits, telegraph circuits, wireless circuits; suitable lettering on all drawings; Underwriter's Code.

Unit 6 *Tables and Graphs.* Preparing tables and graphs from data obtained in shop tests.

Unit 7 *Specifications.* Writing lighting specifications for family house wiring job, apartment house job, theater job; writing specifications for small substation.

Typical Drafting Course for Machinists

Unit 1 *Blue Print Reading.* Machine drawings to include analysis of views, understanding of shapes, number of parts, sizes and materials.

Unit 2 *Shop Sketches from Machine Parts.* Instruction to include measuring simple objects and placing of dimensions on sketches furnished, making sketches in orthographic projection from simple machine parts and necessary lettering on same.

Unit 3 *Geometrical Construction.* Problems such as inscribing a triangle, pentagon and hexagon within a circle, bisecting lines and angles, finding center from three points in circumference, perpendicular, tangents, etc.; necessary lettering.

Unit 4 *Machine Drafting.* To include use of drawing instruments in the construction of simple detail and assembly drawings from sketches already made and others which will be made; practice should be given in the construction of drawings to include reduced scale, section views, titles, bills of material and necessary lettering.

Unit 5 *Mechanism Drawing.* To include a few drawings of threads, levers, conventional representations, and the detail and assembly in orthographic projection of a small machine.

Unit 6 *Isometric Drawing and Sketching.* The drawing of simple objects by use of instruments and practice in freehand isometric.

Note: This course is essentially the same as a related drawing course for patternmakers.

Typical Course in Design for Printers

Unit 1 *Principles of Arrangement.* Purpose and materials of design; surface harmony; proportion; balance, rhythm, symmetry and variety; motion.

Unit 2 *Derivation of Ornament.* Anatomy of ornament; symbolism; esthetics; ornament in nature; inventive ornament; geometric design.

Unit 3 *Typographic Design.* Typography and the fine arts; appropriateness; materials of typographic design; paper in design; texture in ink; type design; legibility; type contrast; type simplicity; decoration; illustration; binding.

Unit 4 *Book Design.* Story of the book; unity; parts of a book; planning a book; size—fitness to purpose; material—text and illustration; type; book decorations; margins; page treatment; presentation.

Unit 5 *Design in Commercial Printing.* Business books; catalogues; pamphlets; folders; circulars; leaflets.

Unit 6 *Typographic Design in Advertising.* And advertisement as a unit; essentials of an advertisement; influence of book design; departure from book design; type in advertising; decoration in advertising; illustration in advertising; advertising symbols; limitation of media; publication design.

Unit 7 *Type and Period Style.* Influence of hand lettering; derivation of type; trade terms for type; type widths; type weights; type families; period style; mongrel styles.

Unit 8 *Color in Typographic Design.* Uses of color; color analysis; values; harmony in color; judging color; simple color combinations.

Unit 9 *Process of Reproduction.* Photographic principles; the three surfaces—relief surfaces; plane surfaces; intaglio.

Typical Drafting for Sheet Metal Workers

Unit 1 *Reading Drawings.* Blue print reading, shop sketching and geometrical construction as outlined for machinists, using sheet metal drawings and models.

Unit 2 *Elementary Drafting.* To include drawing of simple sheet metal shapes by use of instruments.

Unit 3 *Sheet Metal Drafting, Developments and Intersections.* Layout of rectangular objects; layout for folded corners; sketch out for cylindrical objects; finding true length of elements on cylindrical surfaces; determining cylindrical elbows; finding points of intersection of flat and cylindrical surfaces; finding true lengths of elements in intersecting cylinders forming a T; finding true length of elements; cylinders intersecting at any angle; two cylinders intersecting a third to form a V, to find correct length of intercepted elements; true length of elements in conical or pitched surfaces; true length of elements in conical surface cut by

plane at any angle; intersections of mouldings; skylight drawings and intersections; rectangular to round; developments by method of triangulation; oblong to round layouts by triangulation; transitional offset, round to rectangular layout.

B. *Related mathematics, science and trade problems.* A knowledge of mathematical processes and scientific principles is indispensable on the part of trade workers who would be most efficient in the practice of their occupations. Presumably a mechanic should be apt in making mathematical calculations and should understand scientific principles which are in any way applicable to his trade.

A course in strictly related mathematics or science will require a preliminary knowledge of fundamental principles of both mathematics and science and will contain actual applications or examples from the trade without any reference to fundamentals as such. Furthermore in a course which is intended primarily to cover actual trade calculations involving mathematics and science, it is obviously impracticable to separate the two subjects.

On the basis of the conditions just stated, it is recommended that the plan for mathematics and science instruction include: first, separate foundational courses in mathematics, physics and chemistry, and second, specific applications to the trade. The second course will, therefore, be a composite one in which each problem is attacked with reference to its trade application rather than from the standpoint of a unit of instruction in mathematics or science.

1. *First Stage, Mathematics and Science.* Foundational courses in mathematical processes and scientific principles will be required of all trade students either previous to or during the period of trade training. The exact amount of foundational mathematics given in a trade course will depend largely upon that which has been covered by the students previous to entrance into the course.

   The minimum essentials of a foundational knowledge in mathematics and science are indicated below. In planning a course of study adequate instruction should be provided to cover the minimum requirements set up. No subjects previously covered should be repeated in the trade course.

Problems in both mathematics and science as well as practical illustration of principles in science should be taken from the trade. This makes possible the classification of this instruction as related work.

a. Foundational subjects of instruction in mathematics are indicated below. These subjects should be completed during the junior high school period. See mathematics course of study for details.

Unit 1 *Arithmetic.* Fundamental operations; tables of weights and measures; percentage; graphic representations; business practice.

Unit 2 *Algebra.* Equations; formulas; graphic representations.

Unit 3 *Geometry.* Simple geometrical figures.

Unit 4 *Numerical Trigonometry.*

b. Foundational subjects of instruction in science are indicated below. See science course of study for details.

Unit 1 *Physics (Minimum, 3 hrs. per week for ½ year).* Simple and composite machines; force and motion; work, energy and power; mechanics of liquids and gases; light, heat and sound; magnetism and electricity.

Unit 2 *Chemistry (Minimum, 3 hrs. per week for ½ year).* Chemical properties; chemical elements; important chemical compounds; acids, bases and salts; physico-chemico processes.

2. *Second Stage. Trade Problems.* Composite courses in trade problems involving mathematics or science or both will be given in each trade curriculum where such instruction is necessary.

There is a fundamental distinction between the mathematics and science instruction in the first and second stages here indicated. In the first stage, the controlling purpose is to teach mathematical processes and scientific principles. In the second stage, trade situations and examples are the basis for instruction and the mathematical and scientific knowledge acquired during the first stage is used in arriving at a correct understanding or solution of the problem at hand.

a. The following general outline is indicative of the topics which may be included in this course. Not all of the headings will find applications in every trade. The list is rather inclusive, however, and will be found to contain a classification for almost any applied mathematics or science which is likely to be discovered by an analysis of the requirements of any trade.

Unit 1 *Mathematics Section.* Calculations necessary when planning jobs; calculations necessary when using tools and equipment; calculating weights and costs of materials; estimating time to complete jobs; wage calculations to determine labor costs; calculating overhead charges; calculating cost of marketing product; determination of profit.

Unit 2 *Science Section.* Power units and power transmission systems found in the trade (with calculations); circular and linear mechanical movements as applied to the trade (with calculations); analysis of mechanisms used in the trade (with calculations); applications of the mechanical properties of liquids and gases to trade work (with necessary calculations); applications of friction, lubrication, heat, combustion, or fusion to the trade (with calculations); applications of light, color or sound found in the trade (with calculations); applications of magnetism and electricity to the trade (with calculations); chemistry of the materials of the trade; shapes of trade materials; strength of trade materials.

b. An analysis of the machinist's trade reveals the following outline for the course in trade problems. Other trades should be similarly treated when outlining this type of subject matter.

Unit 1 *Mathematics Section.* Calculations for screw thread proportions, gear proportions; measuring stock; speeds and feeds on lathes and drill presses; cutting stroke on planer and shaper; thickness of chips on miller.

Vernier readings; calculations of gear ratios for screw thread cutting; calculations for straight and taper turning; calculations when indexing on miller.

Calculating weights and costs of castings, bars etc.

Making estimates of time to complete jobs on lathe, drill press, milling machine, planer, shaper, etc.

Assuming a wage scale for the shop, to find costs of various jobs and the labor cost on completed product.

Calculation of overhead charges such as power, light, heat, wear and tear on equipment, interest, salaries, lubricants and other supplies.

Calculation of overhead charges such as power, product of a machine shop.

Determining the profit obtained from the sale of the product.

Unit 2 *Science Section.* The steam engine, gas engine and electric motor, their operation in connection with machine shops and their cost of operation; shafts, pulleys, belts, gears and clutches as they are found in connection with single power unit drive, group drive, and individual motor drive.

Examples of linear and circular movements found on lathes, drill presses, planers, shapers, milling machines, emery wheel, pulleys, belts, etc., and calculations of velocities.

Analysis of lathe, drill press, shaper, etc., mechanisms with special reference to the various kinds of motion represented and the transmission of this motion from one part to the other. Relative speeds and ratios of power should also be calculated.

The principles of the hydraulic jack and press, the steam and gas engine, air compressor, and steam hammer should be studied and calculations made in regard to their power and efficiency.

The emery wheel, grind stone, saw, belts, pulleys, bearings, cutting tools, should be discussed from the standpoint of friction, lubrication and heat developed; the effect of heat on metals should be studied; tempering, casehardening, welding, braz-

ing, etc., should be studied carefully; the oxyacetylene torch and electric welding apparatus may be made the subjects of investigation from the standpoints of combustion, temperature and fusion of metals.

The shop power unit or units may often be made the basis for a scientific study of actual electric power installation; operating appliances may profitably be studied and calculations made in regard to their efficiency and operating costs; the electric crane and magnetic lift should also be taken up at this point.

The chemistry of fuels, refractory materials, iron and steel, aluminum, copper, brass, bronze, tin, lead, foundry sands, lime, lubricants, electric insulating materials should be studied. This study will take up the manufacture, uses and characteristics of the above metals.

The methods of shaping metals will be studied, i. e. moulding, forging, rolling, drawing. Each process will be discussed from the standpoint of manufacturing methods and the scientific principles involved. Mathematical calculations will be taken up in detail.

The tension, compression, bending and twisting strength of different metals will be compared and calculations made on the strength of machine parts.

C. *Trade theory.* This subject will contain all the auxiliary trade information which the mechanic should have and which is not contained in drawing, mathematics or science. As in the case of other related subjects, trade theory is very closely related to the shop work. It should be taught by the shop teacher or some other person who is very familiar with the trade practice.

This subject might well be taught in the shop by the shop teacher on shop time if it were not for the fact that shop instruction must at all times refer specifically to production. Under production conditions it is difficult to insure that all of the trade theory content will be covered if given in the shop. For this reason it is always advisable to include in the curriculum a special time for instruction in trade theory.

It is assumed that some of the topics outlined below for trade theory will be taken up in the shop, with individual students. The special class work is not intended to supplant the shop instruction but to supplement it.

The instruction should cover each "block" or section of the trade. Points may be covered which will not be found in the school shop but will likely be met by the student in the practice of his trade.

1. The following outline is indicative of the general field covered in trade theory course. The particular topics will vary in importance to different trades. This subject will be adequately covered for any trade if the topics indicated are sufficiently developed for that trade.

Unit 1 *Trade Terms.* Names of machines; machine parts; tools; processes, etc.

Unit 2 *Safety and Hygiene.* Danger points on machines; danger points in operations; protection against physical injury; dangers from loose clothing and carelessness; legal requirements in regard to shop or performance of work, first aid; occupational diseases.

Unit 3 *Knowledge of Machinery.* The various makes of machinery; special purpose machinery; special attachments; types, use and care of bearings; adjustments; methods of repairing; general care; cost data and quality; good and bad practice in using machinery.

Unit 4 *Knowledge of Tools.* Comparison of the various kinds and makes of tools; special tools; sizes of tools; good and bad practice in the use of tools; cost data and quality.

Unit 5 *Knowledge of Stock.* Different kinds and grades; working qualities.

Unit 6 *Trade Analysis and Special Methods of Work.* Methods of job analysis; analysis of type jobs; comparison of different methods used to do the same job; short cuts.

Unit 7 *Shop Organization and Management.* Organization of machinery for production; personnel; duties and responsibilities of foremen and workmen;

inspection of work; tools and equipment each tradesman should own; shop discipline; hours of work; time-keeping systems; rates of pay and rate setting.

Unit 8 *The Shop Product.* Use of the product; accuracy requirements; finish; rules, regulations, or codes which affect the completed job; distribution or selling methods.

Unit 9 *History and Development of Trade.* Cause for and manner in which trade has reached its present stage of development; future possibilities for development.

2. The following complete outline of trade theory for printers is indicative of the manner in which the general outline given above may be expanded by an analysis of the trade.

Trade Terms. Names of machines, cases, appliances, types, etc., found in print shop and a definition of their use; printer's marks; learning the copy-holder's jargon and how to read.

Safety and Hygiene. Mechanical safeguards; fire hazards; safety precautions; personal responsibility; first aid; compensation; health factors such as ventilation, sanitation, lighting, recreation, diet, personal habits.

Knowledge of Machinery. Oiling, cleaning, and adjusting motors; selection, care and repair of belts and pulleys, care and lubrication of presses, folding machines, cutting machines, wire stitchers, automatic feeders, etc.

Knowledge of Tools. Care of type and furniture.

Knowledge of Stock. Grades of paper; standard sizes and substance of paper; weights of paper; cutting paper; static electricity and its effect on paper; qualities of printing ink; ink on paper; composition of and mixing ink.

Trade Analysis and Methods. Analysis of several jobs which the student has already done in the shop; galley reading and revising; handling author's proof and page proof; correcting display matter; final reading; reading the text; looking out for libel; exercising public criticism; critics' license; learning technical terms; book work makeup; page space and copy; correcting straight and difficult dialogue; correcting commercial jobs; correcting simple tables and headings.

Shop Organization and Special Methods. Jobbing office and book and magazine office organization; general proof-room record keeping; commercial proof-room record keeping; newspaper and periodical proof-room record keeping; administration of various kinds of shops; organization for quantity production.

Finished Product. Job work and special features; newspaper work; periodical and magazine work; book work; selling plans and systems.

History of Printing. Ancient methods; recent developments.

XIX. STANDARDS OF AND MEASUREMENT OF ATTAINMENT.

Scope of this Discussion. Standards and measurements of attainment should be provided for both shop work and related subjects. These two divisions of the student's trade education while every closely related will be considered separately and in accordance with their particular requirements. Standards and measurements for non-vocational subjects are not included in this discussion.

Attainment in Shop Work.

A. *Standards.* A measure of the success of a student in the shop is his proficiency in the performance of his work. His proficiency is dependent upon his ability to acquire an understanding of the fundamental principles of his trade and upon the development of proper habits and skills in the application of these principles to work in the shop. The aims for shop work as set up in Part I, Section XIII, of this Bulletin, state in detail the attainments which are expected of the student. A study of these aims reveals the following standards for measuring success in shop work.

1. A knowledge of trade processes.
2. Skill in the performance of work.
3. Proper methods of work.
4. Quality of product.
5. Speed in production.
6. Adaptability to the environment of the trade.
7. Qualities of leadership.

STUDENT PROGRESS RECORD

Shop.. Instruction Units ....Public Schools

Names																															

STUDENT PROGRESS RECORD

Note: A convenient size for this sheet is 14″ x 23″. It may be duplicated by the VanDyke blueprint method. The print may be mounted on cardboard or sheetmetal and displayed in the shop.

Public Schools—Department of Industrial Education—Shop Record

Name _____ Address _____

Subject _____ Class _____ Year _____

Characteristics and Developments	Degree of Attainment		
	90 — 100	80 — 90	70 — 80
Interest	Enthusiastic	Quite interested	Interested
Application	Very Industrious	Diligent	Steady
Aptitude	Very quick to learn	Apt	Learns readily
Dependability	Trustworthy	Reliable	Satisfactory
Initiative	Excellent	Very good	Good
Co-operation	Excellent	Very good	Good
Knowledge of Processes	Exceptional	Comprehensive	Sufficient
Mechanical Ability	Very skillful	Skillful	Able
Working Methods	Very efficient	Efficient	Satisfactory
Quality of Product	Exceptional	Very good	Satisfactory
Speed in Production	Very rapid	Rapid	Average
Adaptability to Environment	Exceptionally fitted	Well fitted	Contented
Leadership	Exceptional qualities	Very good qualities	Average qualities

SUGGESTIVE

Sheet No. 1

FOR UNIT

First Qr. Gr. _____ Date _____ Second Qr. Gr. _____ Date _____

Third Qr. Gr. _____ Date _____ Fourth Qr. Gr. _____ Date _____

Final Grade _____ Date _____

Quarterly Estimate.				GRADES				
Below 60		60 — 70		1st Qr	2nd Qr	3rd Qr	4th Qr	REMARKS
Disinterested	— —	Lack of Interest	— —					
Lazy	— —	Fair	— —					
Dense	— —	Slow to learn	— —					
Unreliable	— —	Irregular	— —					
Poor	— —	Fair	— —					
Poor	— —	Fair	— —					
Unsatisfactory	— —	Insufficient	— —					
Poor	— —	Uncertain	— —					
Unsatisfactory	— —	Ineffective	— —					
Poor	— —	Unsatisfactory	— —					
Very slow	— —	Slow	— —					
Misfit	— —	Unsettled	— —					
Unlikely qualities	— —	Fair qualities	— —					

SHOP RECORD

TRADE COURSES (Front)

STUDENT PRODUCTION RECORD

Unit Number	Job Number	Name of Job	Estimated Time	Began	Finished	Total Time	Rating	Unit Number	Job Number	Name of Job	Estimated Time	Began	Finished	Total Time	Rating

SUGGESTIVE SHOP RECORD
FOR UNIT TRADE COURSES
(BACK)

Sheet No. 1

Public Schools—Dept. of Industrial Education—Students Perm. Record

Student Information

Name _____ Entrance Age _____ Date of Birth _____ Sex _____
Address _____ Tel. _____ Date _____ Birthplace _____ Nationality _____
New address _____ Tel. _____ Date _____ Hobbies _____
New address _____ Tel. _____ Date _____ Extra school aetivities _____
Last school attended _____ Grade or year completed _____
Previous employment or vocational experience _____

Student's Family

Father _____ Nationality _____, Occupation _____
Home address _____ Tel. _____ Business address _____ Tel. _____
Brothers' occupations _____ Sisters' Occupations _____
Guardian _____ Home address _____ Tel. _____ Business address _____
Remarks _____

Test Data

Test given	Date	Rate	Remarks	Test given	Date	Rate	Remarks	Test given	Date	Rate	Remarks

Course

Course selected _____ Date admitted _____ Started work _____
Course changed to _____ Date _____ Reason _____ App'v'd by _____
Course changed to _____ Date _____ Reason _____ App'v'd by _____

Employment

First Year		Second Year		Third Year	
Occupation	Employer	Occupation	Employer	Occupation	Employer

Physical Record

Date	Height	Weight	Physical Defects	Occupations to be avoided

71

SUGGESTIVE STUDENT PERMANENT RECORD
FOR UNIT TRADE COURSES
(FRONT)

Sheet No. 2
Note: These spaces are for indicating tabs. Trades may be printed in them.

First Year Subjects	Months									Term Grade	Ex. Grade	Final Grade

Second Year Subjects	Months									Term Grade	Ex. Grade	Final Grade

Third Year Subjects	Months									Term Grade	Ex. Grade	Final Grade

Fourth Year Subjects	Months									Term Grade	Ex. Grade	Final Grade

SUGGESTIVE STUDENT PERMANENT RECORD

FOR UNIT TRADE COURSES

(BACK)

Sheet No. 2

B. *Measurements.* In arriving at the attainment of a given student it is essential that the qualities just mentioned be satisfactorily measured. It is necessary, however, that the personal characteristics of the student be given due consideration when rating his degree of fitness. Such personal qualities as interest, application, aptitude, dependability, initiative and co-operation should be given considerable weight when determining the proficiency of a student. The following general method is recommended for measuring the attainments of students in shop work. (See illustrative shop record card).

1. Both the personal characteristics of the student and his success in the accomplishment of the aims of the course should be considered.
2. The degrees of attainment may be classified as excellent, very good, good, fair and poor.
3. A general estimate of the student's attainments should be made at the close of each quarter year on the basis of his characteristics and developments during the preceding quarter.
4. Each job completed by the student should be recorded, together with the time consumed in completing the job and a rating of its quality.
5. The student's record card should be available for his inspection in consultation with his teacher. If properly used it will serve to help him in discovering his weaknesses and improving his work.

Attainment in Related Subjects.

A. *Standards.* In a related subject a student should acquire both a knowledge of the subject matter and an understanding of the relation of these facts to the practice of his trade. These points should, therefore, be considered in measuring the attainment of a student.

B. *Measurements.* The proficiency of a student in subject matter may be measured by tests and examinations such as are usually given for subjects of this kind. A final mark is not complete, however, unless it contains a fair estimate of the degree to which the student applies his knowledge in his trade work. Related subject teachers and shop teachers should confer with each other in determining this factor.

XX. SUGGESTIVE METHODS AND LESSONS FOR SHOP AND RELATED SUBJECTS.

Factors Affecting Choice of Method. The method of presenting instruction to students cannot be standarized. Owing to the necessity of varying the method, it is highly essential that all teachers be conversant with the different forms of presentation as prescribed by good pedagogy.

Some lessons may be taught by the use of one method, while others may demand several methods in order to bring about a clear presentation and a complete understanding on the part of the students. The approach in any case to the teaching of a subject or job is influenced by such factors as the following:

A. Teachable content.
B. Facilities for giving instruction.
C. Age and physical status of the students.
D. Mental capacity of students.
E. The nature of the lesson or subject.
F. Experience and ability of the teacher.
G. Time available.

Variety of Methods May Be Used in Teaching. The following is a suggestive list of methods which may be used by a teacher irrespective of the shop subject or stage of student's development. Due to the fact that the teaching of industrial subjects involves purposeful problems based on concrete projects, it is not deemed necessary to include the "project method" in the following list:

A. Development method.
B. Demonstration method.
C. Illustrative method.
D. Telling method.
E. Textbook method.
F. Lecture method.
G. Trial and error method.

The Use of the Job Sheet in Teaching Shop Work in Day Schools. Due to the fact that a great deal of individual instruction is necessary in teaching shop work to beginners, it is often difficult for one teacher to handle effectively a large number of students at one time. When the teacher depends upon verbal instruction as a means of teaching, the number of students he can handle becomes exceedingly limited in cases where a variety of projects are under construction in the shop at the same time. This is especially true for beginning classes.

Job sheets can be used where the projects, either wholly or in part, are more or less standardized. They are adapted especially to small projects and to parts of larger projects.

The job sheet is an excellent teaching device. By its use the amount of personal attention that a teacher need give individual students is considerably minimized. In many cases, the use of job sheets will make it possible for a teacher to handle a class effectively when under other conditions the class would have to be considerably smaller.

Job sheets should not be used to the exclusion of other effective methods of instruction. It is always advisable for the teacher to give group instruction in certain cases. It is likewise essential that the teacher give as much individual instruction as possible. Instruction by the various methods stated previously in this section is essential and should be selected in accordance with the needs of particular cases which come up during the day's work.

In other words, job sheets do not take the place of the shop teacher. Neither are they intended to make his work easier. They may, however, if properly used make it possible for a teacher to do a better instruction job because his time can be utilized more effectively for individual instruction.

If job sheets are to be of the greatest advantage as an instruction device, they must be carefully graded in regard to the difficulty of completing the job. The jobs at hand may then be assigned to the students on the basis of their ability to do the work.

Job sheets should not be used in the same manner and to the same extent throughout the entire course in shop work. For the beginner a complete job sheet should be provided containing as many details as possible that will help the student in the performance of his work. As he becomes more able to perform the work assigned to him, he should himself be required to construct his own job sheet or plan in accordance with a prescribed form.

Briefly stated some of the advantages and dangers of the use of job sheets are as follows:

A. Advantages.

1. The student has a guide when he begins a project and does not have to wait his turn for instruction.
2. The student always has definite and permanent instruction before him. He does not have to depend entirely on his memory in determining the steps necessary to complete the job.
3. A greater variety of projects can be effectively taught without materially reducing the size of classes.
4. The student learns a definite routine of planning his work and gets into the habit of analyzing each job into its component parts.

5. A greater range of instruction on each project is made possible.
6. A greater opportunity for definite correlation between shop and classroom subjects is made possible.
7. The teacher's time is conserved and he can therefore give more effective individual instruction without so much loss of time on the part of the student.
8. The teacher in some cases is able to handle larger classes effectively.

B. Dangers.

1. Unless properly used the student may "lean" too much upon the teacher's analysis of the job and thus lose initiative.
2. Job sheets may be misused to build up too rigid a program of shop projects.
3. The teacher may rely on the job sheet to the exclusion of other methods of instruction.

The following outline is suggestive of the items that may be included on job sheet. Rather than follow this outline rigidly in constructing job sheets teachers are advised to adapt the items suggested by the outline to the needs of each job that is analyzed for instruction purposes.

Suggestive Job Sheet Outline for Trade Shop Work.

1. Name of Job: Sheet No.——— Code No.———
2. Purpose of completed project:
3. Estimated time for completion:
4. Sketch or drawing:
5. Material required:
6. List of principal tools used:
7. Operations in chronological order:
   (1)
   (2)
   (3)
   (4)
   (5)
   (6)
   (7)
8. Cautions in use of tools and construction:
9. Safety hints:
10. Estimated cost, including labor, material and overhead:
11. New words used:

12. Sources of materials used:
13. References on construction:
14. References for general reading:
15. Remarks:

It is important to keep well in mind the necessity of constructing job sheets that will best serve the purpose for which they are intended. Some of the qualities of a good job sheet are listed below:

A. Sufficient information should be given *to guide* the student in completing the job.
B. The sheet should not contain too much information about the job. The student should be given the opportunity to think for himself.
C. The sheet will not contain any information that does not apply specifically to the job at hand.
D. The component parts of the job sheet should be clearly separated and indicated by appropriate headings.
E. All statements should be clear and as brief as possible.
F. Items 10 to 14 given in the above job sheet outline may often be omitted from the job sheet and assigned to the students as supplementary work.

General Teaching Suggestions for Industrial Teachers.

A. Acquire the habit of careful preparation for every lesson.
B. The introduction to every lesson should be within the range of the pupil's knowledge and his previous experience.
C. Teaching should begin at the point where the pupil's knowledge is lacking. Interest is sacrificed by unnecessary repetition.
D. Secure pupil participation and encourage initiative in order to create a situation favorable to learning.
E. Have in mind a definite objective for every lesson and see to it that the thoughts and effort of the pupil are directed toward the desired objectives.
F. Avoid the mistake of presenting so much material at one time that it leads to confusion in the minds of the pupils.
G. When describing an object it is desirable to display it or represent it by a picture or sketch.
H. Speak distinctly and endeavor to make your language simple and clear. Avoid using technical terms unfamiliar to the pupils without giving an explanation of their meaning.
I. A suggestion from the teacher at the proper time is of definite assitance to the pupils. Unnecessary help decreases resourcefulness.

The Lesson Plan. To make a forceful presentation it is necessary that a lesson plan should be prepared and used. The lesson plan may be made out in skeleton form. The plan, however, should not be inflexible, as the action of the class will usually modify the procedure. If the plan lacks flexibility it usually results in poor student re-action and a consequent lack of proper understanding.

A Few Suggestions on the Preparation of Lesson Plans.

A. *What a complete plan should include.* A complete plan should show (1) the subject of the lesson, (2) the teaching conditions, (3) aim of the lesson, (4) main ideas or points of lesson arranged in proposed order of presentation, (5) proposed method of dealing with the subject matter, (6) verification or testing the accomplishment of the aim. The plan should indicate the references and illustrations to be employed and main questions to be asked.

B. *Steps in lesson planning.* The first consideration in planning a lesson is the subject. The content should then be analyzed, the portions to be dealt with selected and arranged in order for their presentation. The next and final step involves determining what means or method to employ in presenting the lesson.

C. *General suggestions concerning the lesson plan.* The aim or object of the lesson ought to be clearly defined in the mind of the instructor. He should know exactly what he hopes to accomplish by the lesson.

The content of the lesson ought to be based on something which the learner already knows or can do, and should be selected so that the aims of the lesson will be accomplished.

The arrangement should be such that the presentation of the lesson will progress naturally towards the attainment of the aim sought.

Make each lesson complete in itself.

Illustration of Lesson Plan. The following lesson plan for mechanical drawing is typical of the method that may be used in analyzing and planning a lesson.

I. Subject: Tracing

II. Conditions: Class of boys who have made drawings in pencil and ink and are now ready to begin tracing.

III. Teacher's aim:

A. The pupil should realize through experience the use of tracings.

B. The student to apply ink on tracing cloth in a workmanlike manner.

C. The necessity of extreme care in the first stages of learning should be realized by the student.

IV. Procedure in teaching:

Preparation

A. Pencil drawings made by students are before them on the drawing board. (Should be simple straight line work).

B. Necessity for tracings.

C. How to trace.

Presentation and Application of New Material

A. How to tack down cloth:
   1. Locate so as to cover drawing.
   2. Tight and even.
   3. Tacks outside.

B. Preparing surface for ink:
   1. Necessity for pounce or powder.
   2. How to apply.

C. Application of ink:
   1. Relative location of ink and tracing.
   2. Filling pen and danger of blots of ink.
   3. Holding pen and other equipment.
   4. Keep pen moving.
   5. Erasing blots.
   6. Shrinkage of cloth.

Conclusions and Verifications

A. Verification of accomplishments.

B. Application of tracing to the making of a blue print.

Typical Lessons in Shop Work. The following lessons in shop work are typical descriptions of actual instruction in shop work.

A. Lesson in machine shop practice.

Subject: "Chasing a One-Inch Thread."

Conditions: Two of four boys ready for job. Simple geared lathes, belt driven. Boys understand use of simple formulas. First year.

Preparation

Instructor: "Suppose we find out about this job of threading. What kind of a thread are we going to chase, James?"

Student: "The print says one inch, eight threads per inch."

Instructor: "You will notice that it also specifies a United States Standard thread. Here is a chart of U. S. S. threads." (Shows students how to read chart).

Presentation

Instructor: "Now let us look at the end of this lathe. There are three gears that carry the motion from the spindle to the lead screw. The middle gear of the set is used only to connect the other two and has nothing to do with the speeds. The stud or spindle gear and the lead screw gear are the ones that count. Let us put the same size gears on both the stud and screw. Now the lead screw is running as fast as the spindle (demonstrate). The carriage moves forward one thread of the lead screw each revolution of the spindle. If there are four threads per inch on the lead screw there will be four threads per inch on the job."

"Now let us put this into a simple formula:" (on board).

$$\frac{\text{No. threads on lead screw}}{\text{No. threads on job}} = \frac{\text{Teeth in stud gear}}{\text{Teeth on screw gear}}$$

"Therefore, it is only necessary to substitute in this formula the values for lead screw, job threads and one of the gears that may be used as a stud gear. The remaining gear is then found by clearing of fractions. It may be that the resulting gear is not to be had. In this case, select another gear for the stud and repeat."

"Harry, show us on the board how to figure the two gears necessary to chase a one-inch, eight-thread job if the lead screw is four."

Application

The students now go to their respective machines and set the machine for the required thread. The setting is checked by the instructor and the group assembles for further instruction.

Instructor: "This is a sketch of a U. S. S. thread shape. Notice that the top and bottom of the thread are flat for a distance equal to one-eighth of the pitch. How much is this on your thread? Let us go to the grinder and grind a tool."

Instructor: "I now place this tool in the lathe in this manner."

Application

Students now set tools and proceed with the work of cutting the thread.

Testing

The instructor watches for broken tools and spoiled work and keeps a check on the time required to do the job. He compares this time with what he knows to be a reasonable time. The finished job is inspected carefully and fitted to a standard. All work not up to specifications is rejected with a careful analysis of the mistakes made. The job must then be remade until the specifications are met.

B. *Lesson in Pattern Making.*

Subject: Laying out of segments for a blank gear wheel 12″ diameter, 2½″ wide.

Conditions: First job in segmental work—Several boys ready to begin jobs.—Demonstration lesson.

Preparation

"When annular patterns of 6″ or more in diameter are to be made the best method of construction would be by what is known as building up with segments. This method is of great importance and is used repeatedly in all types of jobs for two reasons: (1) it insures a stronger construction, thus increasing the life of the pattern (2) it reduces the warping or changing of shape of the pattern to a minimum."

"Can any one give the definition used in geometry for a segment?" (Answer) "A segment is a part of an object cut off by a line or plane. It is the part of a circle included within a chord and its arc."

"In order to have a better understanding let us think of the orange as an example of segments. After the shell is removed we find the orange is divided into a number of parts. These parts we will call segments."

Presentation

"We now have a general idea about the shape of a segment; let us be more specific and supply our ideas to this job."

A student is now asked how many times approximately the radius of the circle steps around the circumference. Possibly no one has noticed this, so a demonstration is given.

The class will next be referred to the blue prints to find the thickness, outside and inside diameter of the wheel. Attention is called to parts of the job that require machining.

"We know the radius steps around the circumference six times. In making segments we must allow ¼″ extra on the outside and inside for turning off. What dimensions of the segment do we have?" (Any student may answer).

"The wheel is to be 2½" wide, therefore, we must have more than one course of segments. Let us have five courses. The third course will hold the arms of the wheel. How thick should the segments be made and give your reason?" (Answer). "We must now make a template or exact copy of the segment out of cardboard, making the allowance necessary for turning." (Illustrate on the board. "The template has been made. The number of segments and thickness of each segment are known."

"The next step is to lay out the segments, using the template as a model. These pieces should be laid out and cut from the board in such a way that the grain of the wood follows the circle as nearly as possible. That is, in laying out, the chords of the curves should be parallel to the grain of the wood." Illustration.

That a "chord" is the straight line joining the ends of the curve of the segment is then explained.

"This job will be turned up on a faceplate and will require rechucking. Every one has had experience on chuck jobs. What way do you (member of class) think would be the best to fasten the job to a face plate?" Probably one would say by the use of two pieces of paper glued together on the face plate and the work glued to the paper. "Has any one any other method of fastening the job?" (No better way is suggested). "Before we fasten the segments to the plate we must have the radius scribed from the center of the face plate in order to know where the segments are to be placed. Can any one tell me how this is to be done?"

Answer. "The segments are cut and the face plate has been prepared for the work."

"Our next step is to prepare the segments for the face plate. The ends of the segments must be trimmed in order to insure a tight joint. The shoot board or trimmer can be used to trim the ends. You may decide which to use." After the first segment has been trimmed it is nailed to the face plate.

"Care must be exercised in placing the nails to prevent the holes from showing after the work has been turned to size. The nails are to be removed after the job is glued, consequently, they are not driven in their full depth, only enough to hold the segment in place till the glue sets."

"The first segment is located and the rest are nailed until the course is complete. They may now be removed and glued one at a time. Care is taken not to use too much

glue, so that the joints will be strong and close together. In preparing the second course the same method of procedure is followed as in the first course except the end joints are alternating with the ends of the segments in the first course." (Illustrate.)

The next question to be asked would be how long has it been found necessary to wait for glue to harden or set before it is safe to turn work? After two or three courses have been glued, what would you do next?

Each member of the class will be called on to give the various methods of procedure in laying out segments.

Application

Each student is then assigned a job demanding the use of segments.

Testing

During the completion of the job the instructor supervises the work of the students and checks mistakes in procedure or in the use of tools.

The completed pattern is tested for accuracy and finish.

C. *Lesson in printing.*

Subject: Setting the First Issue of the New School Paper.

Conditions: This is not a first lesson in composition; the students have had considerable experience on straight composition and are familiar with terms and equipment here used.

Preparation

"The school is going to have a new school paper to take the place of the old one. The Peabody, as you know, is now printed down town every three months and is costing from $250 to $500, depending on the size of the issue."

"This new paper will be called "The Civitan." While this word is not to be found in the dictionary, it is a good word, nevertheless. It means building up of good citizenship. In the case of our school, it means the building up of a good school citizenship."

"In the building up of our school citizenship, "The Civitan" will occupy the same place as the newspapers do in the building of our civic life. In this work you have a double role. First you have the same part to play as all the other students in your other classes and throughout the building. Second, as workmen on the paper your efforts and achievements will be critically inspected not

only by your parents, the parents of other pupils, the printers of the shops down town, but also by the pupils in the print shops of the other schools who are always trying to excel you in school activities."

Presentation

"I have here the last issue of the "Peabody." You have no doubt already read it. Our new paper will have the same size pages, and the number of pages in each issue will depend upon how much type the classes can set and distribute every two weeks along with other regularly scheduled work. The columns will be 15 ems wide, set in 10 point Caslon Old Style with 10 point Caslon Bold Caps for the headings. The copy such as I have here, will be furnished by the Editorial Department, under the direction of the English Department. Stories will be written on one side of the paper only, and all sheets for one story pinned together and numbered."

"Unless otherwise directed, two leads will be placed after all headings, paragraphs will be indented one em and a 5-em linotype dash put after each story or item. In so far as possible, use a regular space between words. The lines should be spaced out rather than spaced thin to get another word or part of word in a line. Remember to use an em quad after sentences.

"When the bell rings for the class to leave the shop, place a small perpendicular line after the last word set and an X in the left hand margin opposite the line on which you are working as an indication of your stopping place to the next pupil on that stick. It will then not be necessary for him to waste time hunting for the place.

"The type will be dumped on the long galleys placed on the stone and a proof will be taken, read, and corrected before making up in page form.

"No doubt you will be asked by the pupils of the school, your associates, your parents, and friends what part you have had in producing this paper. The answer you give them will depend on yourself. There will be ample opportunity for you to do a fair share of the work.

"I will now give out the copy and each boy will take the case assigned to him and start work. If still in doubt on any point, do not hesitate to ask for more assistance."

Application

Jobs are now assigned and the students go to work. This is a slow process and the instructor should give assistance by passing among the students to answer questions, make corrections in form, handling equipment, and calling attention to errors.

Inspection

After the composition is dumped on the galley, a proof is taken and checked for errors. Individual mistakes are dealt with separately and those of general character should be taken up with the class. The instructor should try to explain them in a manner that will prevent their recurrence.

Lesson in Drafting. The following lesson is typical of actual instruction in drafting.

A. *Lesson in Architectural drafting.*
Subject: Use of Architect's Scale.

Preparation

Lay a set of white-edged scales on desk where they can be seen by students for several days in advance of lesson.

In preparation for the lesson permit the students to try to draw a 12″ square on an 8″ x 10″ sheet of paper. They will soon find out for themselves that it cannot be done. This immediately brings into their minds that some sort of tool or instrument must be used to properly reduce the size of large objects so that they can be shown on a drawing.

Compare the scale to a rule which is so marked that it can be used to make the proper reductions in size.

Presentation

Have students recall the method they used in the geography class in finding the distance from Pittsburgh to Buffalo from one of the large maps.

Show the different types of scales, as flat, triangular, etc., and explain the graduations, methods of reading, care in handling and cleaning.

Application

Give each student a scale and make him responsible for it. Plot the 12″ square on the 8″ x 10″ paper using the scales 6″=1′—0″ and 3″=1′—0″ and have each student follow the process step by step. Check each student to make sure he is reading and operating the scale correctly.

Testing and Follow-up

Give each student a job requiring the use of the scale. Assign the jobs according to the ability of each student.

Check the work of each student and ask him why he used one particular scale instead of another. Make suggestions that other scales be used. Tell him the common practice as to scales in that particular type of work he is doing.

As each student finishes his job, assign a drawing that involves the use of reduced scale. Follow-up until the correct use of the scales becomes a habit.

Lessons in Mathematics and Science. The following lessons are typical of instruction which may be given in foundational science or trade mathematics and science:

A. *Lesson in physics.*

Subject: Levers.

Conditions: Four to six boys in the group. Laboratory near or in shop.

Preparation

Instructor: "If I take a ruler and attempt to pry up this board (suits action) what effect will the distance from my hand to the edge of the board have on the force necessary to pry up the board?"

Student: "If you place your hand on the extreme end of the ruler, you can pry up the board with much less force than if your hand is near the edge of the board."

Instructor: "That seems to be the case, but I wonder if there is some way of finding out what the exact relation between the distance from the edge of the board and the force is. John, go into the shop and cut a piece of pine 2″ x 18″ x 1″. Harry, make a small triangular block like this (makes sketch). James, go to the physics laboratory and borrow a number of one and two pound scale weights. The remainder of the group may look over this instruction sheet and calculate how you are going to use these parts to get a relation between force and distance. Carl, you are the boss on this experiment." (Hands leader instruction pamphlet containing definite instructions.)

Presentation

The students now assemble the apparatus as shown in the instruction pamphlet, and, aided by the instructor only when the ideas of the group are exhausted, proceed to experiment with weights and levers and carefully record the

data obtained on a log sheet given in the instructions. The group now assembles for a study of the results obtained. There is now an understanding that there must be a law governing the lever and the group will usually proceed with enthusiasm to find the solution. A number of questions are now asked by the instruction pamphlet that should lead to a series of thought processes that finally lead up to the solution required.

Question: "If we multiply the weights in pounds by the respective distances from the fulcrum in inches, what is the result?"

Answer: "The two products are numerically equal."

Question: "If this product is always the same, regardless of the distances, how can you account for it?"

Answer: "The lighter the weight, the farther from the fulcrum, and the data obtained show that this can be expressed by a simple formula: Lever arm times weight equals lever arm times weight."

A spring scale is then obtained and class two and three levers are studied in the same manner. As a result of these trials, the group will arrive at a simple general formula for all classes of levers in about two hours.

Application to Trade.

Question: "Examine the feed lever on the sensitive drill in the machine shop. Try to pull the spindle down by hand. Now use the lever. Why is it easier to operate the spindle by means of the feed lever?"

Answer: "The feed lever is a second class lever, and of course the longer the lever arm, the less force is necessary to move the spindle."

Question: "Clamp a piece of work on the drill press. Why do you get a better grip on the job if the bolt is close to the work?"

Answer: "This is a third class lever, and gives no mechanical advantage at all. It would be better to place the bolt through the job itself, but since this is impossible, we get the bolt as close to the job as possible."

Testing

The student now goes into his own shop and sketches an application to some machines. He is required to make a good sketch and to show clearly just how the lever works.

B. *Lesson in trade problems.*

Subject: Determination of the Size of Discs for Setting up Template, having Sides to Be Ground at Exact Angles.

Conditions: Fourth-year boys who are taking the machinist course.

Place: Ordinary classroom, preferably near the shop.

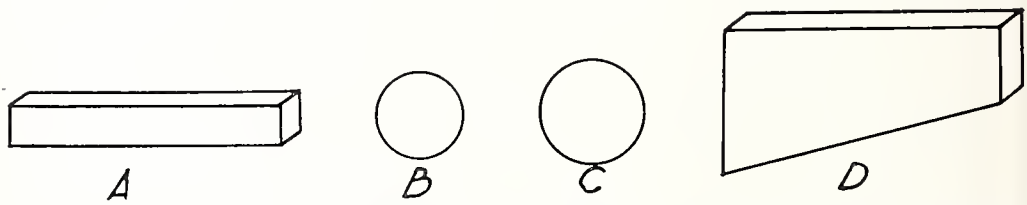
Preparation

Instructor: "How have you learned to set up for grinding a template on which the non-parallel sides must be ground at a certain angle with each other?"

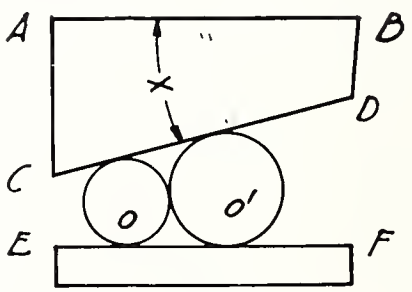
Answer: "By using a sine bar."

Presentation

Instructor: "Today we shall learn how to set up the job without a sine bar because it often happens that a tool room is not equipped with a sine bar."



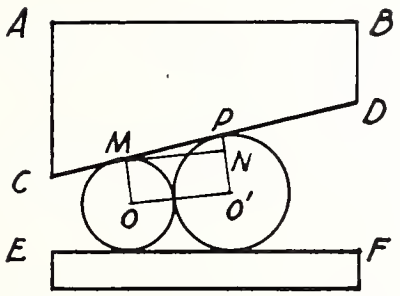
Instructor: "These are all clamped to an angle plate in this manner, (the sketch shown below is placed on the blackboard at this point.)



and the angle plate is fastened to the bed of the grinder. Now as the top surface of the template is ground by passing it back and forth under the grinding wheel it will be made parallel to the upper surface of the parallel block and if the discs which touch each other and the block and template are of the correct diameter, the angle X between AB and CD will be the required angle.

"No matter what the wanted angle is, one of the two discs may always have the same diameter. We shall therefore use for one of the discs a standard one-inch reference disc and determine the diameter of the other disc."

(At this point the instructor completes the sketch as shown below.)



Instructor: "Suppose we wish to grind the template so that the angle between AB and CD is fifteen degrees. Since AB is parallel to EF what is the angle between CD and EF?" Answer: "Fifteen degrees." "Why?" Answer: "Because the angles are alternate interior angles between parallel lines."

Instructor: "If the line OO^1 joins the centers of the discs what effect does it have on the angle between CD and EF?" Answer: "It bisects it, because it passes through two points O and O^1 which are equidistant from the sides CD and EF."

Instructor: "MN is drawn parallel to OO^1 and is limited by the radii O^1P and OM which are drawn to points of tangency on CD. It is therefore equal to OO^1. "Why?" Answer: "Because parallel lines intercepted between parallel lines are equal."

Instructor: "Let the unknown radius be designated by X. The known radius is .5000.

Then OO^1 or its equal MN is equal to X+.5000 and PN which equals O^1P-OM is equal to X—.5000.

Now MPN is a right triangle. "Why?" "Because O^1P is tangent and therefore perpendicular to CD."

Instructor: "We can readily see now that

$$\frac{PN}{MN} = \sin 7^\circ\ 30''$$

Substituting

$$\frac{X-.5000}{X+.5000} = \sin 7^\circ\ 30''$$

Solving

$X = .6501$, the radius of the disc to be turned."

Instructor: "Your problems will be to determine the size of the larger disc, using a one-inch disc as the smaller, for setting up templates whose non-parallel sides make the following angles with each other:
1.18°; 2.22° 30′; 3.25°; 4.32°."

Application and Testing

Problems are worked at home and results are checked the next day.

Lessons in Trade Theory. The following lesson is illustrative of the kind of instruction which may be given in trade theory.

A. Lesson in machine shop theory.

Subject: Cutting Tools—Rake and Clearance.

Conditions: To a class of beginners who have had no experience on a lathe, only demonstrations.

Preparation

"As it is highly important that our tools be properly ground when working on a lathe we will have a demonstration in the use of cutting tools; the kinds to be used on different work; and how to grind them."

Presentation

"I will take a cut across this shaft, with a tool that is properly ground. Notice how the steel forms a perfect curl. It would not curl this way if the tool did not have the proper rake. Who can tell me what I mean by the 'rake' of a tool?" "I will now take a cut with a tool that has no rake and we will observe what happens. What seems to be the trouble?" One boy answers that "instead of a curl coming off the tool, it just comes off in splints or little balls." "Boys, is this tool cutting or crowding the material off?" One boy answers, "It is crowding it off." "When some of you boys were shoveling the snow off your sidewalks, which did you find the easier to do—to shovel it off with the broadside of the shovel or get the shovel in such a position that it would cut it off?" In unison "cut it off." "Well a tool without rake is simply shoving the metal instead of cutting it. It is also possible to grind a tool with too much rake. What is going to be the result in this case? I will now take a cut with a tool that has too much rake and we will see what happens. Can any one see the difficulty with the tool?"

Several hands have raised. "John, what seems to be the trouble?" "It is not cutting any more." "Why?" "Because it is dull." "What made it get dull?" John gives it

up. Henry says, "It seems to be getting hot," but can give no explanation. Clifford is holding up his hand and seems very enthusiastic.

He says: "The tool was too thin and light on the point." He is asked to give an explanation, which he does very well. "That is a very good answer, Clifford. Now how many of you boys have ever tried to sharpen your knives? Did you ever grind a blade so thin that when you cut a piece of wood the edge would turn over? Well, that is exactly what happened to this tool. As you recall from our last lesson on hardening tools, the heat generated from the friction of cutting drew the temper, made it soft, so that the edge turned over and it would not cut. Remember when you grind a tool, be careful you do not draw the temper, also avoid too much rake or not enough. Care must also be taken to get the proper clearance on tools. By clearance is meant that the cutting edge must extend beyond the lower part of the tool.

"For our next lesson, we will take up the different kinds of tools; I will name over a few and you boys can give them some thought in the meantime. There are the round nose, diamond point, parting or cutting-off tools, boring tools, facing tool. Take these down in your notebooks and think over the names very carefully. If you can arrive at some conclusion as to what each one means I will be able to tell which ones have given these things some thought when we get together for the next lesson."

XXI. PLANT AND SPECIAL EQUIPMENT FOR UNIT TRADE COURSES IN HIGH SCHOOLS.

Special Equipment Required. Due to the nature of the work given in unit trade courses, it is necessary to give special attention to the construction and location of the rooms in which the instruction will be given. Special equipment must also be provided with which to give the shop instruction. Some of the related subjects also require special equipment. Specific standards for plant and equipment are given in this section.

The School Plant for Unit Trade Courses. By this is meant the building, rooms and other facilities which are used to house the students, teachers and equipment. General considerations concerning the school plant follow.

A. *Location.* The plant should be located in a strategic position from the standpoint of industries and pupils.

B. *Type of Building.* A factory type of building should be provided when possible, with provision for expansion of facilities when necessary.

C. *Size.* The plant must be sufficiently large to accommodate the number of trades to be taught and the number of pupils.

D. *Kinds of Facilities.* Facilities should be provided for shop work, drawing, laboratory work, recitation and study work, library, assembly, gymnasium, lunchroom, administrative quarters, etc.

School Shop Specifications (general).

A. *Location.* Shops containing heavy machinery should be located on the ground floor if possible. The shops of the industrial group should be located so that they are convenient to each other.

B. *Size.* The floor space required for each shop is dependent upon the requirements of the trade. It will seldom be less than 1,200 square feet and will rarely exceed 3,000 square feet, including all special floor space needed such as finishing room, assembly space, storage space or office facilities.

C. *Doorways.* Doorways of sufficient size should be provided to allow the passage of machinery, etc.

D. *Light.* Natural light should be provided on two sides when possible. An effective window glass area of at least 25 per cent of the floor space should be provided. The side light should be supplemented by skylights whenever possible. Sufficient artificial light should be provided for close work at machines and for illumination on dark days and at night.

E. *Heat and Ventilation.* The temperature of a shop in cold weather may be from 5 to 10 degrees less than that required for ordinary classrooms. At least 40 cubic feet of air per pupil per minute should be supplied for shops in which considerable physical exertion is required of the pupils.

F. *Floors.* Floors should be of wood or wood paving block. Concrete floors should in most cases be covered with wood.

G. *Partition Walls.* Partition walls may be of light frame or hollow tile. They should be easily removable to take care of shop rearrangements.

When class work is done in the neighborhood of a noisy shop, sound-proof walls are desirable. Hollow tile walls are practically sound proof.

Walls should be painted a dark color to five feet from the floor. Above five feet the wall should be of light color.

H. *Ceilings.* Ceilings vary from 12 to 30 feet. Trades like carpentry, electrical wiring, foundry practice, etc., require rather high ceilings, while printing and sheet metal work and the like could be taught to advantage in shops with the minimum ceiling height. In case shop machinery is driven by belts from an overhead line shaft a very high ceiling is a distinct disadvantage.

I. *Stock, tool and supply rooms.* These rooms should always be designed to accommodate the articles to be stored. They should be as convenient as possible to the shop. Some shops will require additional space in other rooms for special purposes.

The same tool room may often be used to accommodate two different shops. Sufficient cases and racks should be provided for storing tools, supplies and other equipment.

J. *Locker facilities.* In some shops it is necessary to provide lockers for the use of individual students. These lockers may be placed in a special room conveniently located. In some cases space in the shop may be utilized.

K. *Wash room facilities.* All shops should be provided with facilities which will make it possible for students to cleanse themselves either before or after work as the case may require. Other plumbing will be installed in accordance with general requirements for high schools.

L. *Power outlets.* Outlets should be provided for electric power. Extra outlets should also be installed to provide for changes in locations of machines in case of necessity.

M. *First aid equipment.* A Red Cross Cabinet containing sterile dressing for cuts and wounds and other simple first aid apparatus should always be provided in shops where machinery or edged tools are used.

Special Equipment for Shop and Related Subjects.

A. *Shop equipment.* This equipment must be adequate to meet the teaching needs of the particular trade course in which instruction is to be given. The following considerations should govern the selection and arrangement of equipment.

1. At least one shop should be provided for each trade taught. The number of shops for each trade will depend upon the number of pupils receiving instruction. Not more than twenty pupils should be under the instruction of one teacher in a shop at a given time. On the basis of two classes per day a maximum of forty pupils can be taken care of in one shop. In some trades

less than twenty pupils should be in the shop at the same time. In some cases it is possible to give instruction to more than twenty pupils if sufficient space and equipment is available and an additional teacher is provided. A two-teacher shop has important disadvantages, however, and will be approved only when the conditions surrounding such a plan seem to warrant its use.

2. The type of equipment should be comparable to that found in the local industries.
3. The working capacity of the equipment selected should be determined by the products which will be turned out in the shop.
4. Good quality should be a consideration in favor of selecting any one kind of equipment.
5. The quantity of equipment will vary with the size of classes. For a class of twenty pupils more equipment will be needed than if fewer pupils are given instruction at one time. It is sometimes possible to distribute the purchase of a complete equipment over a period of two years.
6. The variety of eqnipment will vary somewhat with the length of the course. In a one or two year course it is advisable to teach a few processes well rather than a great variety with a consequent lack of thoroughness.
7. Representative makes and types of one kind of machines should be selected rather than a full quota of the same type or make. For example if ten engine lathes are required they should not all be of one make. A variety of makes will give the student a wider acquaintanceship with standard lathes.
8. The units of equipment should so far as possible be arranged in relation to each other so as to facilitate the planning and routing of work in accordance with the best industrial practice.
9. A blackboard should be provided for the use of the teacher in giving instruction.
10. All equipment must be safeguarded to meet the requirements of the Pennsylvania Department of Labor and Industry.

B. *Related subject—special equipment.* This includes only that equipment which will be used in drawing and science. Science may be taught by the use of equipment used for

ordinary high school instruction supplemented by frequent illustrations from the shop. In the absence of suitable science equipment a number of valuable experiments may be performed by the use of equipment made by the students in the school shops. Drawing equipment is rather well standardized and will vary little for different trades.

C. *Initial cost of shop equipment.* This cost is comparatively high. It varies, however, with the trade and with the variety and quantity required. A great opportunity exists either to waste a great deal of money or get adequate returns on the investment. The principles enumerated above in regard to the selection of shop equipment, if properly applied, will lead to the purchase of good and adequate equipment at minimum cost.

PART II

ADMINISTRATION AND COURSES OF STUDY FOR VOCATIONAL GENERAL INDUSTRIAL CLASSES

I. GENERAL INDUSTRIAL COURSE DEFINED.

In general industrial courses, instruction is given in two or more trades of a trade group. In Section XV of the unit trade course of study examples of trade groups are given.

In a general industrial course pupils enroll for training in a group of trades and receive instruction in each of these trades for periods of time depending upon the total length of the course and the number of trades in the group.

II. CONDITIONS UNDER WHICH VOCATIONAL GENERAL INDUSTRIAL COURSES MAY BE ESTABLISHED.

General industrial courses on a vocational basis, under the provisions of the State and Federal laws, may be established only in communities of less than 25,000 population.

This type of vocational course is permitted in cities of less than 25,000 population for the following reasons:

A. The Federal Vocational Education Act permits special regulations for communities of this class "in order to meet the particular needs of such cities and towns."

B. It would often be financially impossible for the smaller city to establish a complete system of unit shops for persons who have chosen a particular trade or occupation.

C. In many small city high schools it would not be possible to get a sufficiently large group of students to elect unit trade courses to warrant the establishment of separate shops for a number of trades.

D. Sufficiently large classes graduating from unit trade courses would in some communities furnish so many trade workers that the industries would be unable to absorb them.

III. UNIT TRADE COURSES ARE PREFERABLE TO VOCATIONAL GENERAL INDUSTRIAL COURSES WHENEVER POSSIBLE.

In small communities that have predominating industries, such as will warrant the establishment of unit trade instruction, such classes should always be established in preference to general industrial classes. The unit trade course gives students a more definite preparation for entrance into industry than does the general industrial course.

IV. GENERAL AIMS FOR VOCATIONAL GENERAL INDUSTRIAL INSTRUCTION.

The general aims for this type of instruction are the same as those stated for unit trade work in Section III, of the unit trade course of study. Due to the fact that, in a general industrial course, training is given in a group of trades, the preparation for any one trade is obviously less complete than would be true in a unit trade course.

V. CONDITIONS WHICH DETERMINE THE SUCCESS OF VOCATIONAL GENERAL INDUSTRIAL COURSES.

Refer to Sections IV to XI of the unit trade course of study, which discusses these conditions for unit trade courses.

A. *Basis for establishing courses.* This is the same as has been stated for unit trade courses. (See Section IV, under Unit Trade.)

B. *General organization for the administration of courses.* This is the same as has been stated for unit trade courses. (See Section V, under Unit Trade.)

C. *School conditions affecting courses.* These are the same as have been stated for unit trade courses. (See Section VI, under Unit Trade.)

D. *School and industrial relations affecting courses.* These are the same as have been stated for unit trade courses. (See Section VII, under Unit Trade.)

E. *Specific requirements for courses which are fixed by law.* With the exception that a minimum of 25 clock hours of instruction per week are permitted for these courses, the legal requirements are the same as for unit trade courses. (See Section VIII, under Unit Trade.)

F. *Standards which are indicated in the law but interpreted by the State.* With the following exceptions these standards are the same as those which have been indicated for unit trade schools. (See Section IX, under Unit Trade.)

1. *Productive work.* Shop work should be on a useful or productive basis. However, exercises for producing skill may be used more frequently here than in unit trade classes.
2. *Plant and equipment.* In the small school, a vocational general industrial shop may contain equipment for more than one trade. Pupils in the same shop under one teacher may be working on projects of different trades at the same time.

When a sufficient number of pupils are enrolled in the general industrial course it is desirable to have unit shops and a teacher for each shop.

G. *Variable conditions surrounding the operation of vocational general industrial classes.* (See Section X, under Unit Trade.) These conditions are the same as those stated for unit trade courses.

H. *Initial steps in investigating need for and obtaining State approval of the establishment of vocational general industrial courses.* (See Section XI, under Unit Trade.) These steps are the same as those which have been stated for unit trade courses.

VI. GENERAL CONSIDERATIONS IN PLANNING THE SCHOOL PLANT AND EQUIPMENT.

Refer to Section XII of the course of study for Unit Trade work.

A. *Types of high schools to be considered.* Courses will be found in the same type of high schools as stated for unit trade courses.

B. *Persons and agencies to be consulted when planning.* Similar persons and agencies should be consulted when planning these courses, as have been indicated in connection with unit trade courses.

VII. OUTLINE BY YEARS FOR VOCATIONAL GENERAL INDUSTRIAL CLASSES.

Refer to Sections XIII and XV of the unit trade course of study for detailed discussion of this subject.

A. *Specific aims for instruction.* Practically the same aims as stated for unit trade schools may be applied here. These aims will be modified, however, in accordance with the variety of trades and the length of the training period in each trade.

B. *Subjects and topics to be treated.* The shop work and related subjects for any trade of the group as well as the relative amount of time given to each subject during a given period are the same for general industrial courses as have been stated for unit trade courses. The variety of trades in which training is given to each student will necessarily modify the total number of hours given to the shop and related instruction of any one trade.

1. *Suggestive trade groups.* See Section XV of the unit trade course of study. It is sometimes necessary to reclassify the trade groups to meet specific conditions in a community.

2. *Typical two-year vocational general industrial curriculum.* The following curriculum is designed to meet the needs of a community where the working population is employed in metal working and electrical manufacturing industries. Some of the processes learned in each of the trades will be valuable in the practice of the others. For instance, if the student becomes a machinist, he will better understand the control and operation of electrical power units by virtue of his electrical shop experience; in like manner if he becomes a manufacturing electrician, his machine shop knowledge will contribute to his ability in turning armatures, winding coils, etc. It is assumed that pupils entering this course have completed the sixth school year and are 14 years of age.

a. First Year—first term	Periods of 45 minutes
Practical Work	
Pattern shop	20
Related Instruction	
Machine pattern drafting	3
Arithmetic	4
General science	3
Trade theory	1
Non-vocational Instruction	
English	5
History	4

b. First Year—second term	
Practical Work	
Sheet Metal Shop	20
Sheet Metal Drafting	4
Related Instruction	
Arithmetic	4
General science	2
Trade theory	1
Non-vocational Instruction	
English	5
History	4

c.	Second Year—first term	Periods of
	Practical Work	45 minutes
	Machine shop	20
	Related Instruction	
	Machine drafting	3
	General mathematics	4
	Chemistry of materials	3
	Trade theory	1
	Non-vocational Instruction	
	English	5
	Civics	4
d.	Second Year—second term	
	Practical Work	
	Electrical shop	20
	Related Instruction	
	Electrical drafting	3
	Numerical trigonometry	4
	Mechanics and electricity (elementary)	3
	Trade theory	1
	Non-vocational Instruction	
	English	5
	Civics	4

VIII. SUBJECT MATTER FOR VOCATIONAL GENERAL INDUSTRIAL SHOP COURSES.

Outlines of subject matter for unit trade shop work are suggestive of subject matter content for general industrial courses. (Refer to Section XVII of the unit trade course of study.) In adjusting the suggestive unit trade subject matter to meet the requirement of a general industrial course, units of instruction may be reduced in extent. In some cases it is also advisable to discard some of the blocks which require more advanced skill or knowledge.

IX. CONTENT OF RELATED SUBJECT COURSES FOR GENERAL SCHOOLS.

The content of related subject courses for a general industrial class will be similar to that of like trade courses when given on a unit trade basis. (See Section XVIII of the unit trade course of study.)

A. This subject matter will usually be abbreviated. The fact that instruction is given in a number of different trades, reduces the amount of time devoted to instruction in any one trade.

B. The following conditions should be recognized when outlining subject matter for vocational general industrial courses:

1. *Drawing.* The subject matter for drawing at any given point in the course should be related specifically to the shop work which is being given at that time.
2. *Mathematics and science.* As in unit trade courses, mathematics and science instruction will be divided into two stages—

   The problem work in courses of a foundational character (first stage as indicated for unit trade courses) may be related to any trade of the trade group regardless of whether the student is working in that shop at the time or not.

   The problems given in strictly trade mathematics and science (second stage as indicated for unit trade courses) should relate definitely to the shop work which the student is doing at that time.
3. *Trade Theory.* Trade theory at any point in the course should relate definitely to the trade at which the student is working.

X. METHODS OF INSTRUCTION AND MEASUREMENT OF ATTAINMENT.

Practically the same methods of instruction and the same standards and measurements of attainment may be used for both unit trade and vocational general industrial classes.

XI. PLANT AND EQUIPMENT.

The same general standards for plant and equipment hold for vocational general industrial classes as have been stated for unit trade classes.

When it is planned to teach more than one trade in a shop, the room should be sufficiently large to accommodate all of the machinery and equipment. It should be of such a shape as to admit of proper supervision by the instructor from all parts of the room.

The kind of equipment used for general industrial classes is similar to that listed for unit trade courses.

The arrangement of equipment in general industrial shops will be slightly different from that in unit trade shops because (1) the shop work is not always on a useful or productive basis, (2) more than one trade may be taught in one shop, (3) one teacher may teach more than one trade in the same shop. The arrangement of equipment in the vocational general industrial shop of more than one trade should follow the plan indicated for the general shop in the course of study for industrial arts classes.